~~F. AHLFELD~~

OUTER CONTINENTAL SHELF
DATA MANAGEMENT SYSTEM
DEFINITION

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Prepared for
Bureau of Land Management
U.S. Department of interior

30 March 1975

By
Energy and Resources Division
THE AEROSPACE CORPORATION

LT5.21

Outer Continental Shelf

Data Management Sys tern Definition

Prepared for

U. S. Department of the Interior

Bureau of Land Management

Washington, D. C.

By

Energy and Resources Division

The Aerospace Corporation

El Segundo, California

(under Contract No. 08550 -CT5-21)

Approved by: G. F. Kuncir

G. F. Kuncir
Senior Staff Engineer
Resource Programs

FOREWORD

Item 6 of the Outer Continental Shelf (OCS) Environmental Studies Program, BLM OCS Study Contract #08550 -C T5-21, requires that The Aerospace Corporation define and document a basic Data Management System for submittal to the Contracting Officer's Author - ized Representative (COAR) at the Bureau of Land Management (B LM), Washington, D. C. Office. This report fully des tribes all work accomplished and findings related to the investigation of that Task.

The Data Management System defined in this report was designed within the requirements delineated in the Environmental Studies Program statement of work. It is believed that this report satisfies the requirements for content as outlined in the OCS Study contract. However, this is the only major report within the study that does not permit a draft to be submitted with subsequent interplay of ideas between B LM and the originators prior to the final form. We believe, as noted within this report, that interplay is extremely important.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLES

Tables (Cent'd)

Page

APPENDIX E

ILLUSTRATIONS

Illustrations (Cont'd)

Figure | Page

APPENDIX D

Illustrations (C ont'd)

1.0 SUMMARY

Although oil and gas exploration, drilling, operation and abandonment have been experienced in specific locations on the Outer Continental Shelf (OCS), the activities to date are minimal in relation to intended future leasing programs. The governments' intent is to use the known and suspected vast energy resources of the OCS to alleviate substantial portions of the Nations energy needs in the near future (5-10 years).

Contravariant to this goal is the opposition to such growth by many elements of our society. This opposition has been increased by past experiences with disastrous accidents related to exploration of energy resources from the OCS (e. g., Santa Barbara oil spill, 1969). These opposing forces have been ins trumental in obtaining legislation, statutes, etc. , imposing regimented procedures, requirements and guidelines on Federal agencies when exploitation of resources are involved and the quality of the e on-ment is also at stake (e.g. , NEPA).

The U. S. Department of Interior, and many of its agencies are directly involved in this controversy over increasing demands for energy and the maintenance of a quality environment.

In relation to current and planned mineral extraction from the OCS, the Bureau of Land Management (BLM) is tasked by Interior to develop an Environmental Studies Program for the OCS addressing issues of concern. This entails, in general, development of baseline sampling criteria, monitoring criteria and prediction techniques to assess at any phase of oil/ gas activity the status or impact of such activity on the quality of the environment, and to develop corrective actions, when appropriate.

Inherent to this responsibility is the acquisition, processing, analysis and evaluation of vast amounts of data (as the leasing programs are expanded) which will be required for effective assessments of conditions or as inputs to decisions related to the oil/gas programs.

The subject of this report is Item 6, " The Data Management System Definition", of the ' 'OCS Environmental Studies Program, " contracted by BLM to The Aerospace Corporation. An overview of this task is presented in the following.

1.1 Objectives and Scope

The basic objective was to "define and document a basic data management system for the orderly flow of information between data cone c - tions, analysts, and the program decision make rs. " In achieving this objective "every effort will be made to design the system to be compatible with (1) existing government owned/leasing proces sing equipment that is available to the OCS Environmental Studies Program and (2) other software programs /routines that have been developed for processing or analyzing similar data.

The s cope included, but was not limited to, evaluation of data needs, geographic areas of concern, agencies involved, user requirements, hardware availability, software system availability, utility and functional programs available, status of related oceanographic projects, status of on-going OCS data projects and state -of-the-art for processor/software combinations.

1.2 Approach

Initial efforts were directed to contacting involved agencies. groups or individuals, acquisition of relevant data or information and categorizing obtained mate rial. Subsequently, the tasks were to develop desired Data Management System (DMS) requirements, to assess alternate approaches to meet requirements, to evaluate existing hardware and software systems that were candidates, to investigate existing oceanographic or water quality data systems and to recommend, from these tasks, an implementation plan for the B LM OCS Data Management Sys tern.

1.3 Obvious Study Deficiencies

Although considerable definition of a recommended Data Manage - ment System was developed, this definition lacks solid information relevant to data needs that will emanate from other efforts or studies not yet completed. For example:

- complete description of all measurements that will be required for the OCS Environmental Baseline, the downstream OCS Environmental Monitoring, the specific geographic areas, etc.
- for the above, the accuracy, the number and the frequency of measurements to be taken
- the proc es sing, handling or identification of samples
- specific data retention or retrieval requirements.

Alongwith the above, not all inclusive, deficiencies is the obvious need for active interplay on the proposed DMS described herein with involved agencies, groups or individuals before specific implementation tasks for a BLM OCS DMS is pursued.

1.4 Study Ground Rules and/or Assumptions

The primary ground rules and/or assumptions used in this study were:

- The DMS should consist of a centralized facility with remote access from the field (alternates were reviewed)-
- The DMS should provide timely access alongwith the ability to manipulate data for display and analysis.
- The priority for selection of processors would be equipment (1) owned and operated by BLM (2) owned and operated by DOI (3) owned and operated by other government agencies (4) CSC Inf onet and (5) commercial.
- Pursuant to the above, candidate computers were established as:

/B LM	B5500, Denver, Colorado
/B M	B5500, Denver, Colorado
/BR	CYBER 74/28, Denver, Colorado
/GS	IBM 360/65, Washington, D. C.
/GS	IBM 370/155, Reston, Virginia
/USDA	IBM 360/65, New Orleans, Louisiana
/csc	UNIVAC 1108 (GSA), El Segundo, California

1.5 Data Considerations

The data needed for the OCS Environmental Studies Program has been somewhat structured for specific areas (e. g. , Mississippi, Alabama, Florida. (MAFLA), is being developed for other areas, and has not yet been quantified for many OCS locations. Related oceanographic and water quality data needs have, however, been addressed by many agencies (Federal, State, University, et al) over the years and basic types of information exist for establishing criteria for acquisition, processing, etc. Examples are NODC, EPA, GURC, and Westinghouse.

As to the quantity, accuracy, frequency, etc. , of needed OCS data, the picture is not as yet very clear. If MAFLA was taken as representative of the 17 identified OCS areas (and it certainly would differ in many respects) and the data requirements identified there (conservatively 300, 000 items) were merely multiplied - the total OCS requirement would approximate 5 million items of data. A gross inaccurate approximation, but useful in developing the DMS concept postulated herein.

The need for data by the BLM Regional or field offices covers the gamut from hydrography, biological, to social-economic conditions of states contiguous to the OCS area of concern. Further, the agencies involved in the total data problems range from Federal (B LM, GS, FWS, EPA, FPC, et al), those in states affected and the public. The interface, interactions and interplay of “participants” are complex.

1.6 Data Management System (DMS) Requirements

The DMS should support the BLM OCS Minerals Management Program whose goals include the orderly development of marine resources on the continental shelf and the protection of the marine environment. To assist in these goals, the DMS must provide BLM investigators and decision makers with timely, accurate information drawn from an accumulation of data and observations made by BLM and other agencies with responsibilities on offshore lands.

The DMS must provide (1) a repository for all OCS environmental data, (2) means for detecting change, (3) methods to relate change to cause, (4) techniques for early warning of impact, and (5) modes to aid research in prediction. The System should also allow the users at various offices or laboratories immediate access to reguired information with provision for preparation and dissemination of requisite reports.

Finally, the system should be configured to allow for incremental growth - from near term needs to maximum potential for the total OCS areas.

- Basic Design Objectives

The basic design objectives utilized in definition of the DMS were;

(1) A computer-based system available to all BLM users.

(2) Broad-based data storage, retrieval, computational, summary and modeling capability.

(3) Rapid response and at a minimum turn around time.

(4) Easily interfaced to user prepared programs.

(5) Simple for users to learn and operate.

(6) Flexible modular design for adapting to new requirements.

(7) Computer hardware independence.

(8) Minimum maintenance.

- **Design Goals**

The top level design goals necessary to achieve the above objectives are:

(1) User Orientation
(2) Flexibility
(3) Program Modularity
(4) Program Expansion
(5) Minimum Use of Computer Memory

- **Design Requirements**

Specific design requirements are outlined herein and range from storage capability, interactive, batch and remote batch, access, user command structure, etc. to catalogs, file definition, text storage, data base recreation, management system architecture, etc.

- **Documentation Requirements**

Thorough and well organized documentation is required to allow for growth and convenient updating with emphasis on completeness and clarity. Types required are:

(1) Users Guide
(2) Computational System Description
(3) Executive System Description
(4) Program Listings

1.7 Proposed DMS Design

The DMS proposed use of a centralized BLM facility for which all users have access to the data base either by direct batch mode methods or through a remote terminal, The computer used is available within the medium-to -large stale government installations reviewed.

The DMS design provides for (1) the use of a general data base management system, (2) open-ended computational and modeling capability, (3) easy adaptation to new requirements , (4) flexible application, (5) efficiency in operation and (6) simplicity of structure.

The proposed concept combines a system of functional and utility proces sing programs, related to individual analysis needs, linked together by interface logic and controlled by an executive program that will allow users to exercise processors in whatever sequence necessary for any particular study. System elements include:

- User Specification Processor
- Execution Processor
- Utility Processor Library
- Functional Processor Library

1.8 Computer Hardware Assessment

In accordance with BLM direction, seven computer hardware systems were examined for application in the DMS. Each with summary comment are itemized below:

(1) B5500, BLM, Denver - unacceptable for DMS due to present batch mode and planned replacement (January 1976)

(2) B5500, BM, Denver - unacceptable for DMS due to short term usefulness, being replaced (August 1975)

(3) Cyber 74/28, BR, Denver - heavily committed and the refore rejected for DMS

(4) IBM 360/65, GS, Washington, D. C. - suitable for DMS, due to become DOI service machine, availability hard to assess

(5) IBM 370/155, GS, Reston - suitable for DMS, availability uncertain

(6) IBM 360/165, USDA, New Orleans - suitable for DMS, dedicated to USDA mission, not recommended for DMS

(7) Univac 1108 (INFONET) - potential capability for DMS, not a high priority choice

Of the above, the potential availability of the GS machines and a new B LM facility in Derive r appear to offer most promise.

1.9 Software Assessment

In the software area, three areas were evaluated:

(1) Four existing oceanographic and water quality data systems; namely, GURC, NODC, EPA and Westinghouse

(2) Seven data proces sing packages; namely, EDMPAS, GIM, GIPSY, IMS, NODC, STORET and System 2000

(3) Numerous functional and utility software systems

All four in (1) above would require extension of capability to meet DMS needs and were therefore rejected. Possible interim processing capability is attractive, however. Of the seven data processing packages in (2) above, only System 2000 is deemed appropriate for DMS. For (3) above, the selection from a plethora of programs is dependent on user requirements not yet identified.

1.10 Recommended Implementation

Based on what is considered a preferred DMS configuration and the availability of hardware and software systems, a two phased implementation program is recommended.

Phase I would entail use of the DOI IBM 360/65 for system development and pilot testing.

Phase II would involve translation of the DMS from Washington, D. C. to the B LM facility in Denver, when it is sufficiently configured to accommodate the DMS.

The data base management system recommended would be SYSTEM 2000 in both phases.

During the implementation, development and test in Phase I, an interim capability could be achieved by BLM through arrangements for use of NODC or GURC.

The recommended DMS has been designed in keeping with identified system requirements and is schematically shown in Figure 1-1, following.

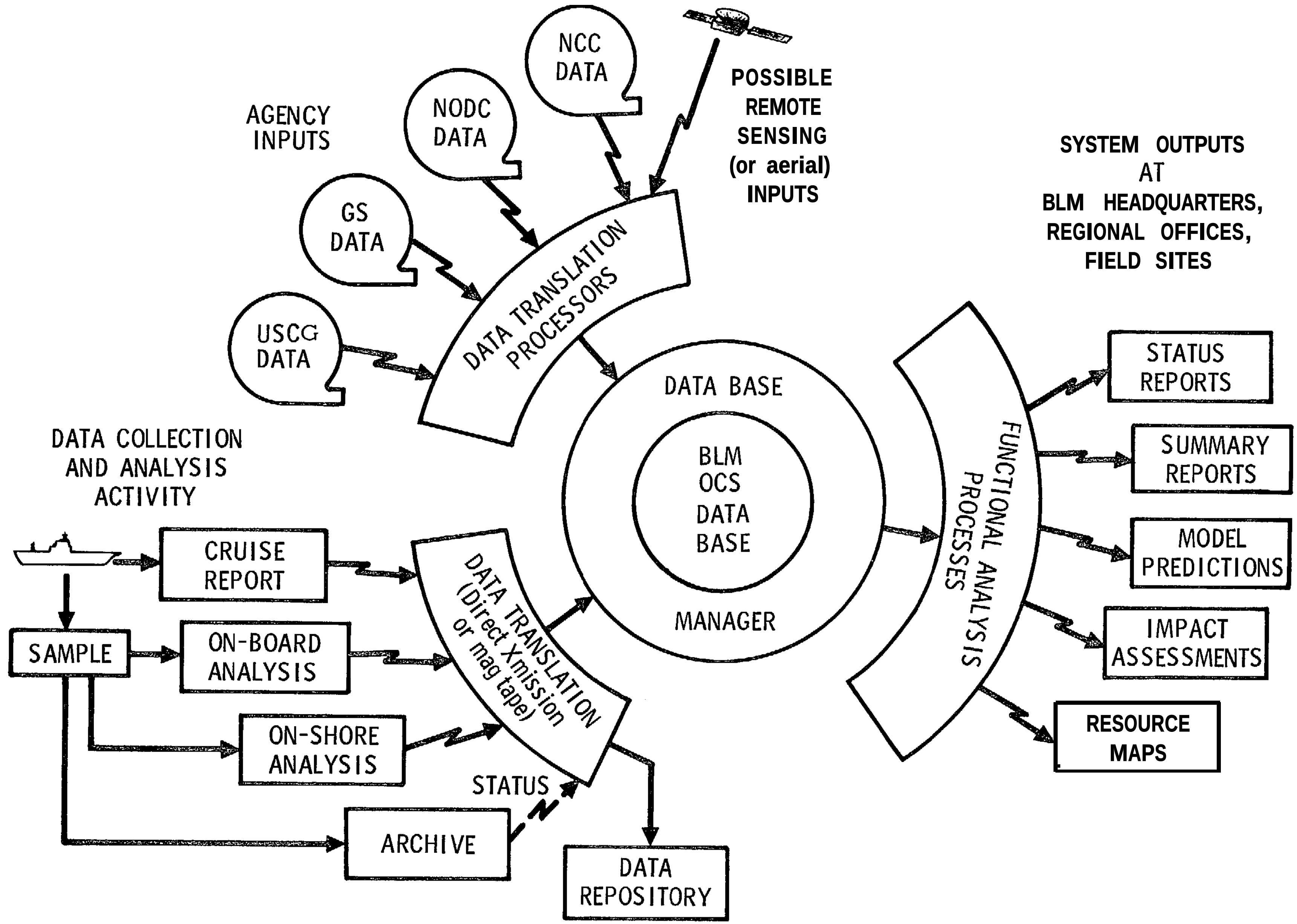


FIGURE 1-1. RECOMMEND DAT/ MANAGEMENT SYSTEM

2.0 INTRODUCTION

There are many controversies over the projected expansion of the leasing program for oil/ gas exploitation on the Outer Continental Shelf (OCS). The Nation's need for additional energy resources is in conflict with many elements of society keenly concerned with environmental disturbance. The U. S. Department of Interior, aware of these concerns, has through the Bureau of Land Management (BLM) initiated the requirement for an OCS Environmental Studies Plan to address questions associated with environment on the OCS during current and planned oil/ gas activities.

The OCS Environmental Studies Program has been contracted to The Aerospace Corporation (Contract No. 08550 -CT5-21). This report covers Item 6 of that Program, OCS Data Management System Definition.

This document presents discussions on data needs, agencies involved, design concepts, hardware and software assessments, recommended Data Management System for implementation and related Appendices.

3.0 STUDY DESCRIPTION

3.1 Information System Need

To fulfill its responsibilities for the management and protection of federal Outer Continental Shelf (OCS) lands as directed by Congressional statute, the U. S. Department of the Interior (DOI) through the Bureau of Land Management (BLM) must be cognizant of all actions related to those lands on a continual basis. Information of interest, in connection with the proposed OCS oil and gas development, includes an Environmental quality baseline; lease status, platform permit and construction status; the environ. mental con ditions during exploration and production operations; and the status of any mineral development on adjacent state tide and submerged lands .

While the potential volume of data that must be gathered to satisfy BLM's environmental monitoring responsibility alone justifies the use of a data management system of fairly elaborate proportions, the geographic separation of BLM offices and contracted investigators requiring access to the data, the scope of necessary oceanographic studies, and the diffuse nature of non-BLM information sources necessitates the development of a well-planned system specifically tailored to fulfill the present and future needs of BLM's OCS program. This system should be responsive to requirements levied by decision-making program management in BLM headquarters and in field offices. Further, the system should assist in the detailed accounting associated with the collection, analysis and storage of environmental samples acquired during field investigations, yet provide a sophisticated tool for an application in scientific analyses and in the evaluation of environmental impacts.

3.2 Basic Task

Recognizing the need for a data management system to support its activities, the Bureau of Land Management 's Division of Minerals Environmental Ass es sment as signed the Aerospace Corporation the task of defining a basic system to provide for the orderly flow of information between data collectors, analysts and program decision makers. This is Item 6 of the OCS Environmental Studies Program which the Aerospace Corporation is contracted to perform for BLM. The work statement is provided below.

> Data Management Definition - The Contractor shall define and document a basic data management system for the orderly flow of information between data collectors, analysts, and the program decision makers.
>
> Every effort will be made to design the system to be compatible with (1) existing government owned/leased proces sing equipment that is available to the OCS Environmental Studies Program and (2) other software programs/ routines that have been developed for processing or analyzing similar data,

3.3 Study Approach

The Aerospace study effort entailed a series of meetings and telephone contacts with organizations currently using data base management systems for environmental observation data, with BLM personnel having requirements which must be met by the system to be defined, and with IBM personnel who have conducted a survey of DOI computing capabilities and will propose a plan satisfying DOI future needs within the next few months. Table 3-1 lists the primary contacts.

In addition to direct contacts with involved agencies or personnel, the Aerospace effort included a search through open literature describing data base management systems used by government, a review of product summaries describing commercially available systems, and a detailed analysis of material acquired from the Environmental Protection Agency (EPA), Geological Survey (GS), Gulf Universities Research Consortium (GURC), National Oceanographic Data Center (NODC), and Westinghouse Oceanic Research Laboratory. A review of the final MAFLA baseline study reports was also performed. These were acquired from the Bureau of Land Management Regional Office in New Orleans, Louisiana.

The hardware studies undertaken for this task made extensive use of Aerospaces previous and continuing involvement in computer system

TABLE 3-1. REPRESENTATIVE CONTACTS (Sheet 1 of 2)

Organizations	Personnel	
Bureau of Land Management (BLM)	R. Barkey	H. Hyatt
Los Angeles, California	R. Brock	R. Lawton
New Orleans, Louisiana	F. Cuadrado	J. Linne
Washington, D. C.	D. Deberard	D, Lipka
	V. Ehlerding	F. Monastero
	E. Forsee	H. Sieve rding
	W. Harem	E. Tennyson
Council of Environmental Quality (CEQ)		
Washington, D. C.	J. Reisa	
Department of Agriculture (DOA)	L. Porche	
New Orleans, Louisiana		
Environmental Protection Agency (EPA)		
Cincinnati, Ohio	S. Conger	P. Taylor
Washington, D. C.	F. Leutner	C. Weber
Geological Survey (GS)		
Menlo Park, California	L. Bray	R. Kelley
Metarie, Louisiana	L. Deiter	W. Martin
Reston, Virginia	R. Either	R. McNally
Santa Barbara, California	J. Ficke	J. Morrison
	D. Giroir	H. Oden
	L. Hammons	C. Shawen
Gulf Universities Research Consortium (GURC)		
Galveston, Texas	I. Miller	J. Sharp
International Business Machines (IBM)		
Gaithersburg, Maryland	P. Friedman	P. Thomas
	B. Porter	

TABLE 3-1. REPRESENTATIVE CONTACTS (Sheet 2 of 2)

Organizations	Personnel	
National Oceanographic Data Center (NODC) Washington, D. C.	A. Barge ski J. Churgin	R. Holmes
State University System of Florida Institute of Oceanography (SUSIO) St. Petersburg, Florida	P. Blizzard M. Rinkle	R. Smith
Westinghouse Oceanic Research Laboratory Annapolis, Maryland	D. Ela T. LaCrosse	H. Palmer C. Ransome

activities for other agencies within the federal government.

Using information gained through the noted contacts and reviews, systematic studies and evaluation were performed to develop the system concept contained herein.

4.0 OVERVIEW OF OCS DATA (STATUS AND NEED)

The geographic areas of concern to the OCS Environmental Studies Program are shown in Figure 4-1. The status report on current data gathering efforts and discussion of overall needs are presented in the following.

4.1 Baseline Environmental Surveys

The objective of OCS baseline surveys is to establish environmental conditions as they are before oil and gas development commences. This set of data may be referred to as benchmark data, pre-drilling data, or baseline data depending on the length of time studies have been conducted and on the extensiveness of the measurements.

If collected in sufficient time, the data can be used for: site selection (i. e. , Gulf of Alaska or South Texas), tract selection or tract exclusion, preparation of environmental impact statements, preparation of special lease stipulations, changes in operating orders and/or regulations governing existing leases, and as a baseline against which future measurements taken during the monitoring phase may be compared for the purpose of determining changes in environmental conditions.

Development of an overall strategy for establishment of a baseline in a given geographic area is dependent upon many factors, but must consider all of the following: Hydrographic conditions, the nature of biologic populations, ambient levels of hydrocarbons and certain trace metals, existing natural hazards. In general, baseline environmental surveys are directed to provide the best information, within time and monetary constraints, in the following subject areas:

- Hydrography - there must be adequate data to aid in the prediction of spill trajectories, and to characterize the natural environment.
- Biology - the nature and variability of natural benthic and plankt onic populations should be known. Ambient levels of

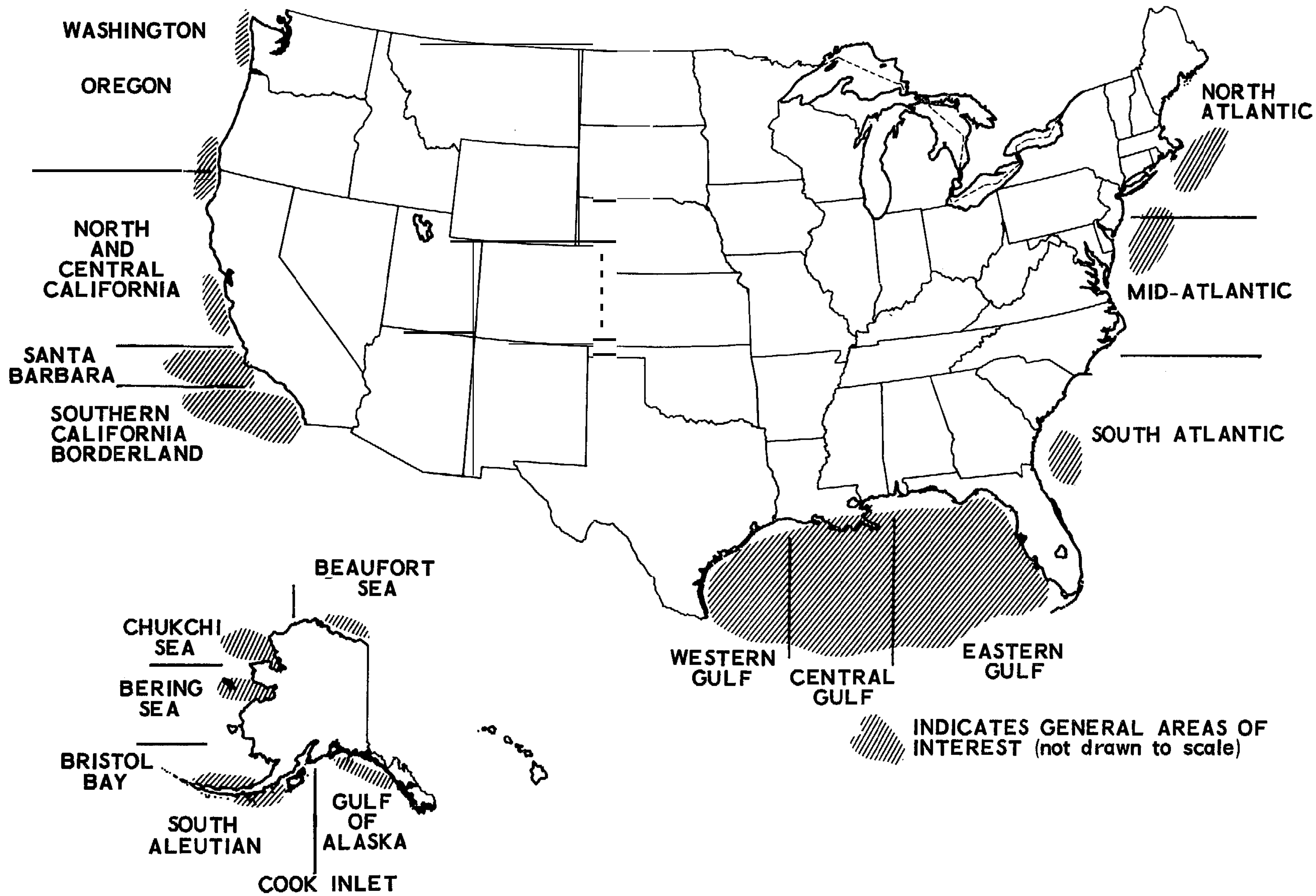


FIGURE 4-1. OCS REGIONS OF INTEREST FOR OIL AND GAS EXPLORATION

hydrocarbons and trace metals must be established. The ultimate goal is to be able to distinguish between natural variability and man-induced changes.

- Geology - sediment characteristics, including geochemical parameters, mineralogy, grain size distribution, the nature of clay minerals, and the aerial extent of these parameters are important measures of existing conditions. Near-surface, or surface structural features such as growth faults, mud lumps, underground springs, or buried karst topography that indicate unstable bottom conditions should be mapped from seismic records.

- Resource Evaluation - studies must be adequate to assess other natural resources such as fisheries and wildlife potential or mineral potential other than oil and gas. Recognition of natural sources of petroleum hydrocarbons from underwater seeps is also essential.

- Weather Conditions - simultaneous data on atmospheric and oceanographic conditions can aid in developing a circulation and spill trajectory model with a high degree of reliability.

Below, several on-going and proposed environmental baseline surveys are summarized.

4.1.1 Mississippi-Alabama-Florida (MAFLA) OCS Baseline Study

The MAFLA baseline study was begun in April, 1974, and was conducted by the State University System of Florida Institutes of Oceanography (SUSIO). It constituted an intensive short-term effort at collecting oceanographical, biological, and geological information in the MAFLA area before the scheduled exploration activities were begun. Classical oceanographic techniques were employed in the data collection period, including water collection for microbial biomass, micronutrients, low molecular weight hydrocarbons, dissolved oxygen, organic carbon (particulate and dissolved), trace metals, particulate high molecular weight hydrocarbons, temperature, salinity, and depth, and stepped oblique tows for zooplankton using . 5 meter nets with opening/closing devices. All these samplings were done on 15 master stations and 4 control stations. Bottom sampling was accomplished on 40 master stations and 25 control stations. This sampling included the following: box cores for infaunal macrofauna, hydrocarbon analysis, trace metal analysis, total organic carbon, and sediment analysis. Bottom photography and dredges were used for characterizing epifauna and epiflora.

Analysis of samples taken during the 60 day sampling period has recently been completed and a final report summarizing the study was released in March, 1975. This analysis included the sorting and identification of organisms, sedimentological characterizations, and the chemical analyses of water, sediments, and organisms to determine the baseline levels of hydrocarbon and trace metal contamination, Quality control checks on the chemical analyses were also provided for in the contract. (A summary of the MAFLA data base is included in Appendix B). It is felt that the research effort produced substantive information which will provide an adequate baseline against which future changes due to oil and gas operations can be compared.

In conjunction with the MAFLA baseline study, a contract was awarded to SUSIO, University of Alabama, University of Miami, Texas A&M University and NOAA's Atlantic Oceanographic and Meteorologic Laboratory (AOML) in Miami to compile, summarize, and present all existing hydrographic data for the eastern Gulf of Mexico. Data includes what is available from National Data Centers, published literature, unpublished research results, and personal files. This study will provide the best available analysis of the circulation patterns in the deep water of the Eastern Gulf and continental shelf, and will show the relationship between the two. Availability of the data will enable the Bureau to plan future sampling programs in such a way as to maximize the quality of data being returned. It will also enable the prediction of spill trajectories from offshore platforms and probable impact to water column organisms as a result of a spill.

4. 1.2 Gulf of Alaska Baseline Data Gathering

A baseline environmental data gathering plan similar to the MAFLA baseline study has been proposed for the Gulf of Alaska. It is planned that NOAA, in conjunction with the Geological Survey and the Fish and Wildlife Service, will conduct the study. While some work by NOAA ships has begun, full implementation of the required sampling work has yet to get underway.

4. 1.3 Other Potential Data Gathering Programs

Environmental baseline studies similar to the MAFLA and Gulf of Alaska programs are planned for initiation in calendar year 1975, in the South Texas area, Southern California, and at some undesignated site on the Atlantic coast. The South Texas baseline study will be conducted by the Geological Survey in Corpus Christi, in conjunction with the Fish and Wildlife Service, NOAA, and Texas universities. Implementation of the sampling program in South Texas also awaits budget approval. The studies in the other areas are still in the planning stages.

4.2 Environmental Monitoring Programs

Environmental monitoring programs are the natural follow-up programs to the environmental baseline programs. Utilizing similar sampling and analytical techniques, and previously identified sampling sites, additional collections of organisms, sediments, and water will be accomplished after exploration (and possibly production) have begun. After analysis and data reduction, a comparison of the environmental parameters measured can be made, and an estimate of the correlation between the observed changes and the degree and proximity of oil and gas development can be developed. This program should also include monitoring of individual drilling rigs in order to evaluate the total environmental effect of rig placement and operation. Later when, and if, there is sufficient production from a field to warrant construction of a pipeline to shore, detailed pipeline corridor studies must be completed.

There is no question that the greatest environmental impact of spilled oil would be in the coastal zone, and that an understanding of these sensitive and vital transition areas is essential. Spill trajectory analysis based on hydrographic and meteorologic data will delineate those coastal areas most likely to be affected in the case of a spill, thus permitting more intensive studies and better definition of ambient conditions. Studies of toxic and sub-lethal effects of native crude on selected organisms will aid in answering the question of long-range effects of development and production and will also establish criteria for determining what are dangerous levels of hydrocarbons and when these levels are reached.

Monitoring studies in all geographic areas that have baseline studies will continue for several years after the onset of development, in order that the longer range impacts may be quantified. Parallel to these OCS baseline and monitoring studies will be site specific studies for areas of special interest, and special subject studies to better understand particular phenomena. At the present time, no monitoring programs have been designed, and no contracts awarded or memoranda of understanding between agencies formulated. Preliminary planning by the OCS Research Management Advisory Board (See Appendix A) has begun, however.

5.0 SPECIFIC OCS DATA CONSIDERATIONS

OCS field office data needs are many and varied depending upon the state of OCS area activity. Activities performed by field office staff in support of the BLM OCS land management and protection role include:

- Resource analysis for tract selection.
- Site specific environmental impact statement preparation.
- Revision and update of OCS knowledge, including the definition of natural changes and the preparation of incident case histories.
- Incident asses sment and evaluation including source determination and prediction of shore impacts.
- Assessment of clean-up effectiveness.
- Environment degradation detection.

5.1 Types of Data

The information presented below defining the types of data required to support BLM activities was gathered from interviews with BLM field office staff. It should also be mentioned that the timely access to data and the ability to manipulate it for display and structural analyses was an expressed concern.

Geology

- Physical Geology

  Faults, dips, thrusts, synclines, anticlines

  Plate tectonics

  Earthquake epicenters

  Ocean depths
- Petrology
- Mineralogy (types, location, potential reserves
- Stratigraphy (layering of sediments)

  Depth, thickness and deposition of sediment strata
- Geo-phenomena

  Earthquakes

- History
- Potential
  - Direct seismic vibrations
  - Area affected
  - Duration
- Affects
  - Ground breakage
    - Horizontal and vertical displacement
    - Location and extent
    - Direction
  - Landslides (submarine, sub-aerial)
    - Location and extent
  - Liquefaction of sediments
    - Location and extent
  - Differential Settlement
    - Location and extent
  - Seismic sea waves (tsunami)
    - History
    - Potential
    - Location

Volcanic Activity

- Same effects as earthquakes (except liquefaction)
- History and potential
- Location
- Type of eruption
- Hazard areas
- Unstable sea floor

- Gee-morphic

  Historic record of the formation of the ocean floor

Meteorologic

- Seasonal information regarding winds, storms, visibility, fog, structure icing, dew point, ice fog, 25-50-100 year cycle trend plus maximum storm and monthly precipitation.

Physical and Chemical Oceanography

- Tides - extremes, season of extremes, velocity and volume of transport
- Currents - velocity and direction
- Surface and subsurface circulation - direction of movement, velocity

- **Sea state (waves and swells) - wave height and periods, 25-50-100 year history of wave heights, maximum wave heights and projected data.**
- **Onshore floods - location, extent, projection history and cyclic trends.**
- **Salinity - dissolved salt in parts/1, 000.**
- **Water Temperature - surface and thermocline depth by month.**
- **Ice - probable areas of occurrence, history of frost in degree days by month. Ice hazards.**

Oceanography

- **Sediments - Sediments in suspension in milligrams/liter including particulate organic carbon. Turbidity and ph are needed.**
- **Chemical Analysis of Water - oxygen, phosphate, nitrate, nitrite, ammonia, silicates, dissolved organic carbon, trace metals, nutrients and toxic substances.**
- **Pollution source data.**

Coastal and Marine Animals

- **Zooplankton and Benthic Invertebrates**

  Species list
  Life cycle
  Distribution (by season for marine)
  Abundance (by season for marine)
  Habitat requirements (by season for marine)
  Productivity
  Effect of pollution upon
  Ecological significance
  Historical accounts of population (Benthic Invertebrates)

- Fish

  Species list
  Species distribution by season
  Seasonal migration patterns
  Species abundance
  Life cycles
  Historical account - populations
  Food habits/ requirements
  Habitat requirements (water/0_2)

- Commercial fishing statistics by species and oceanographic region
- Effects of oil pollution
- Fisheries industry (harvest by species and statistical region - economic importance)
- Biological/ecological significance
- Endangered/threatened species
- Critical habitat areas

- Mammals/Birds
  - Species list
  - Species distribution by season
  - Seasonal migration patterns
  - Species abundance by season
  - Species density by season
  - Food habits/requirements (seasonal)
  - Species behavioral adaptations (human disturbance, vessel traffic, aircraft traffic, noise)
  - Habitat requirements
  - Species historical account (distribution and population)
  - Life cycle
  - Endangered/threatened species
  - Management policy (state and federal)
  - Effects of oil pollution
  - Biological/ecological significance
  - Marine mammal rookeries and/or concentration areas - map catalog (indicating abundance)
  - Seabird colony map cataloging which includes abundance
  - Critical habitat areas

- Decomposes (coastal upland and marine)
  - Species list
  - Life cycle
  - Location
  - Distribution
  - Abundance
  - Effects of pollution

- Plants
  - Species list
  - Life cycle
  - Distribution by season
  - Abundance
  - Habitat requirements
  - Productivity
  - Effects of pollution upon
  - Ecological significance

Location Specific Information

- Archeological and historical site inventory.
- Access to BLM land status system.
- Naval Oceanographic Office information related to shipwrecks and nautical hazards.
- Shipping lane location, traffic, use and restrictions.
- Lease status, encumbrances, mineral production data, authority terms, OCS operating orders, special lease stipulations.
- Platform locations, status, production, inspection review, accident history.
- Pipeline locations, status, capacity and accident history.

Oil Accident Information

History (cause, damage)
Probability of oil spills in a particular area
Probable movement (vert. and horiz.) of oil spills
Rate of spread
Time estimate of bio-degradation
Reaction time for containment
Availability of equipment
Volume of spills
Status of corrective action

Socio-Economic Information (Contiguous States)

- Population (state, regional, local)

Density
Composition
   Race
   Age
   Education
   Income
   Occupation
   Average length of residency
Employment'
   Work force composition
   Occupational composition
Unemployment
   Available work force composition
   Social characteristics of the unemployed

Income
Employed by occupation
Available unemployed by occupation
Age groups
Race
Education

- Social Infra-Structure (state, regional, local)
  Expressed per 1000 people

  Hospital beds
  Police
  Firemen
  Classrooms (elementary, secondary, college)
  Acres of recreational areas
  Child care centers
  Mental health facilities
  Public safety expenditures
  Public facilities expeditions
  Bonded indebtednesss
  Teachers - students
  Etc ....

- Industrial Infra-Structure (state, regional, local)

  Industry Category
  Employed and available unemployed by industry. Seasonally and annual average.
  Labor supply projections - short run and long run.
  Capital or labor intensiveness of each industry on a comparable scale.
  Seasonal annual average, and median incomes per industry.

- Regional Economics

  Tax rates - income, sales, corporate, etc.
  Average wages and salaries
  Basic and non-basic industries
  Industry inventory
  Property values

Administrative Information

- Research contract status.
- Index of appropriate jurisdictions and agencies for a particular subject.
- Public and official query service.

- Abstract on environmental impacts, economic impact of cultural integration and industrial dislocation, and opportunities cost of industrial development.

5.2 Parameter Requirements

The use of environmental parameters to support various investigations is illustrated in Table 5-1, extracted from the Research Institute of the Gulf of Maine (TRIGOM) study and other sources.

5.3 Map Display Needs

Finally, the question of data presentation. Interference and effect cannot be easily discerned from inspection of large tabulations of data. In the OCS environment, a map is the most adequate method of data presentation. The following was extracted from a BLM report discussing the subject:

Foremost in the OCS mineral leasing program is the need for accurate, comprehensive maps showing offshore lease blocks. To date, the plan coordinate system of the adjacent state has been used in laying out the 5000 acre (Louisiana) or 5760 acre (Texas and the Pacific coast) blocks. This has resulted in problems such as negative coordinate numbers in the OCS, and numerous zone changes resulting in fractional lease blocks. OCS lease maps for the Atlantic and Gulf coasts and Alaska are being prepared based on the Universal Transverse Mercator system to minimize this problem.

Besides lease maps, there is a pressing need for comprehensive and up-to-date hydrographic, bathymetric, biologic, geologic, and geographic maps. In most OCS areas, detailed maps of these types do not exist. If they did, they would provide ready access to data for the preparation of environmental impact statements, and would facilitate long-range planning efforts by delineating the least environmentally sensitive areas. Outlined below are the specific types of maps that BLM requires.

TABLE 5-1. ENVIRONMENTAL PARAMETER REQUIREMENTS

ACTIVITY	DIRECT EFFECTS	PARAMETERS REQUIRED
1. Dredging and spoil disposal 1/	a. habitat 10Ss	a. habitat inventory (70 10Ss over time, historical or endangered environ- ments - i.e. wetlands) productivity index of habitats
	b. destruction and loss of resident biota	b. inventory of biota by habitat and notation of those species endangered or threatened
	c. interference with ground water quality and quantity	c. water table contours and quality, identification of major aquifers
	d. salinity intrusion	d. estuarine salinity profiles, ground water contours
	e. turbidity	e. delineation of bottom sediments; current levels of turbidity and current sources of sedimentation, current 0_2 profiles
	g. contamination of dredged and disposal site with toxic elements in sediments	g. inventory of sediments - source, origin, age; sedimentological parameters (texture, heavy minerals, toxins)
2. Construction of Pipelines 1/	a. disruption of bottom habitat - open ocean	a. same as (a) and (b) above
	b. turbidity - open ocean	b. temporary effect; dependent on type of sedimentation and current sedimentary levels
	c. disruption of drainage in wetlands	c. watershed drainage systems

TABLE 5-1. ENVIRONMENTAL PARAMETER REQUIREMENTS (Continued)

ACTIVITY	DIRECT EFFECTS	PARAMETERS REQUIRED
	d. destruction of marsh vegetation	d. inventory of unique or endangered vegetation
	e. loss of habitat	e. inventory of habitats and ecosystems
	f. erosion	f. topographic contours, soil maps
3. Supertanker Operations 1/	a. increased turbulence, scouring and wave generation causing erosion and sediment transport, and increased turbidity	a. channel depths, composition of sediments, existing turbidity levels, existing 0_2 levels
	b. increased navigation hazard -	b. level of use by small crafts; incidence of accidents in past
	c. spillage of oil - causing 1. damage to beaches, -recreation impacts -mollusk damage -destruction of bird nesting habitat	c. 1. Beach inventory -level of recreation use -extent of clam and mussel flats -definition of wildlife habitats and species nesting in intertidal zone
	2. damage to estuaries and their ecosystems	2. Estuary inventory - description of ecosystems and key species including shellfish and finfish larvae
	3. damage to marsh vegetation and soil erosion	3. wetlands inventory - type of plants and soil (relative tolerance to oil pollution)

TABLE 5-1. ENVIRONMENTAL PARAMETER REQUIREMENTS (Continued)

ACTIVITY	DIRECT EFFECTS	PARAMETERS REQUIRED
	4. destruction of species - decreased species diversity (toxic effects to organisms)	4. species diversity indexes - areas already stressed, areas of high quality, areas marginally stressed, tolerances of key species, trophic diagrams
	5. disruption of feeding or breeding or other behaviors of birds and mammals and other key species	5. life histories of key species
	6. sublethal damages to organisms	6. life histories of key species (life span, productivity incidence of disease, etc.)
	d. oil spillage - nature of damages variable according to physiography, hydrography, weather conditions	d. physiography hydrography weather conditions
4. Platform Construction 2/	a. turbidity	a. bottom geology
	b. bottom habitat 10Ss	b. habitat inventory, species inventory
	c. new habitat loss	c. migration pattern
	d. visual dis ruption	d. delineation of recreation areas and distance within line of sight
	e. navigation hazard	e. level of shipping and commercial fishing traffic, and routes
5. Drilling Operations 2/	a. turbidity from offshore disposal of drilling muds	a. habitat and species inventory

TABLE 5-1. ENVIRONMENTAL PARAMETER REQUIREMENTS (Continued)

ACTIVITY	DIRECT EFFECTS	PARAMETERS REQUIRED
	b. 10Ss of bottom habitat from disposal of drilling cuttings	b. habitat and species inventory
	c. change in salinity in area around drill rig from disposal or formation waters (brines)	c. life histories of species in pelagic and offshore bottom habitat - tolerances to changes in salinity.
	d. burden on on shore waste treatment or disposal systems in areas adjacent (or on offshore disposal areas if available) from solid wastes; and oil or acid contaminated waters	c. availability of waste disposal sites - onshore and offshore
6. Construction of Onshore Storage Facilities 3/	a. loss of available land (possibly wetlands)	a. land use inventory (especially wetlands)
	b. when wetlands filled or drained lowering of water table, release of organic nutrients to surrounding waters, loss of natural buffer to wave and wind erosion, possible contamination, of groundwater; loss of fish and wildlife habitat	b. delineation of aquifer systems; definition of existing stresses on water quality; list of species in salt marsh habitat - especially those endangered or threatened
7. Construction of Refineries and Petrochemical Complexes 3/	a. increased air and water pollution loads.	a. existing air and water quality conditions. Needs of refineries and petrochemical complexes

TABLE 5-1. ENVIRONMENTAL PARAMETER REQUIREMENTS (Continued)

ACTIVITY	DIRECT EFFECTS	PARAMETERS REQUIRED
	b. loss of lands	b. same as for storage facilities.
	c. demands on water supply	c. water supply capabilitiess
	d. demands on electric power	d. power generation sites and capacities
8. Construction and Operation of Drill Rigs, Storage Facilities and Refinery Complexes 3/	a. demands on labor force - both temporary and permanent	a. labor force statistics
	b. increased income and tax base, overtime	b. total earnings/company
	INDIRECT OR INDUCED EFFECTS	
	a. demands on housing - increased rents; increased use of marginal units	a. cost of living index for the area; housing starts/yr.
	b. demands on municipal services - schools, hospitals, garbage collection, sewage treatment, transportation, power, etc.	b. excess capacity of existing services or excess demand

NOTES: 1/ Activity and Direct Effects information taken from the Corps of Engineers Report on Gulf Coast Deep Water Port Facilities - Vol. IV, Appendix F. 1973.

2/ Activities and Direct Effects taken from BLM Draft Environmental Statement, Proposed 1973 OCS Sale No. 32, p. 21.

3/ Activities and Direct Effects taken from both Corps and BLM reports, and additional sources. “

Knowledge of current patterns, water masses and temperature -salinity data is essential in environmental prediction for oil and gas and hard mineral exploitation. These factors bear heavily on pollution control and dispersal of pollutants and on the distribution of organisms that may be affected by such pollution.

Bathymetric maps and profiles provide, in conjunction with geologic maps, information about subsurface structure and its surface expression which aids in location of mineral resources. Surface minerals such as sand and gravel can also be located and mapped with the aid of adequate bathymetric charts. Most important, changes in bathymetry resulting from OCS operations can only be ascertained if good base maps are available initially.

Maps showing the surficial and subsurface geology of offshore regions and the contiguous onshore regions, as well as isopach, structure, and tectonic maps can be useful in ascertaining the salability of lease blocks . They aid in delineating the location and extent of surficial deposits, and sometimes give clues to their origin, Structural and mechanical stability of a given area, particularly in delta regions, may be evaluated, and measures for safe operations may be anticipated by consulting geologic, structural, and tectonic maps.

Having an adequate knowledge of the biology of an area is essential to good environmental protection and prediction. Maps and profiles showing micronutrient concentrations, dissolved gases (including oxygen), and fish and wildlife population density distributions would provide integrated data and enable BLM to initiate and maintain mineral recovery programs that harmonize with the environment. Ecologically dangerous situations could be avoided thus enhancing the environment over the long run.

Charts and maps showing climatic and meteorologic conditions, mineral and energy consumption and resources, population distribution, and recreational and park areas are vital to the total analysis of environmental impact on coastal areas. These types of maps would rapidly supply information for a quantitative analytical method of determining the environmental impact of offshore drilling. They would give an overview of possible alternative sites and resources in the immediate area, the proximity of human resources, and the positive and negative effects that the proposed operations will have on these.

6.0 THE OCS , AGENCIES INVOLVED AND LEASING PROGRAM

The location, agency jurisdictional environment and planned leasing program in which the proposed OCS Data Management System must function further define its necessary breadth and scope.

6.1 Agencies Involved

A detailed discussion of the various responsibilities of involved agencies is presented in Appendix A. In summary the following is presented.

The Secretary of Interior (DOI), through the BLM, is responsible for the administration of mineral exploration and development on the OCS. BLM and the Geologic Survey (GS) select tracts for leasing based on DOI goals and the requirements of the National Environmental Policy Act (NEPA).

Environmental analyses for risk of impact are initiated by BLM and involve the following agencies:

Geologic Survey
National Park Service
Fish and Wildlife Service
Bureau of Outdoor Recreation
Bureau of Mines
National Marine Fisheries Service
Environmental Protection Agency
Department of Transportation
Federal Power Commission
Federal Energy Administration
Affected States
The Public

After lease bids have been accepted, supervision of the operation is assigned to the GS, with BLM maintaining overall responsibility for the protection of the OCS. Other agencies maintain specific responsibilities as well, for example:

U. S. Coast Guard - Navigation, Safety and Inspection

Office of Pipeline Safety (OPS) - Pipeline Safety

Environmental Protection Agency (EPA) - Criteria and Enforcement

Corps of Engineers - Navigable Waters

In addition to the foregoing, the Secretary of Interior established (March 20, 1974) the Outer Continental Shelf Management Advisory Board to advise on matters related to design and implementation of environmental research projects related to oil and gas exploration and development on the Ocs.

6.2 Leasing Program

Specifics of the overall leasing program are presented in Appendix A. The Presidential directive to lease 10 million acres of OCS lands in 1975 more than triples the acreage previously offered (annually). This expansion will include areas where there has been no oil or gas development in the past and in many cases, lack of baseline environmental data.

The magnitude of the pending problems has caused the BLM to all field offices in the regions of concern and to materially increase its staff. Other involved agencies are also being augmented.

7.0 DATA MANAGEMENT SYSTEM REQUIREMENTS

7.1 General Considerations

An OCS Data Management System is to be developed to support the BLM OCS Minerals Management Program whose goals include the orderly development of marine resources on the continental shelf and the protection of the marine environment. To assist in fulfilling their goals, the Data Management System must provide BLM investigators and decision makers with timely, accurate information drawn from an accumulation of data and observations made by BLM and all other agencies with responsibilities on offshore lands. Data that will be stored and maintained by the OCS Data Management System includes baseline observations defining the existing environment in all OCS areas, data gathered subsequent to any mineral development lease in accordance with an established environmental monitoring program, environmental data gathered for special investigations, and data gathered by other agencies including USGS, DOT (U. S. Coast Guard and Office of Pipeline Safety), EPA, Corps of Engineers, FWS, NOAA, and the governments of states adjacent to federal OCS lands.

The Data Management System must provide a repository for all OCS environmental data and provide a means for detecting changes in the OCS environment. When changes are detected, the System must have the capability to relate these changes to natural causes such as ocean currents or weather disturbances, to land-linked urban or agricultural sources or to OCS oil and gas exploration or production activities. The System should provide a means for early warning of impending environmental impacts and supply data to aid basic research efforts in determining the long-term effects of oil and gas operations on the continental shelf with respect to the marine ecosystem. The System must provide its users in various offices and laboratories scattered throughout the country with a relatively immediate access to analytic, statistical and data processing tools needed to support their analyses, accommodate a simultaneous flow of observation data and service requests, and supply users with merged, up-to-date information and reports necessary for program administration, impact asses sment, and basic research conducted from regional offices, investigator's facilities, or BLM headquarters.

Although the System must be versatile in its basic implementation, it must also be capable of incremental growth to fulfill future operational requirements and yet maintain a consistent compatibility with systems containing data required to support its information goals. Compatibility y must also be maintained with systems available in government to minimize time delays, start-up and operational costs -- both for computer hardware and software elements.

7.2 Operational Environment

The BLM OCS Environmental Studies Program will be conducted from BLM headquarters in Washington, D. C. and from major regional field offices in New York (Atlantic Office), New Orleans (Gulf of Mexico Office), Los Angeles (Pacific Office), and Anchorage (Alaskan Office). Other field offices may be maintained in Boston, Savannah, St. Petersburg, San Francisco, Corpus Christi, Santa Barbara, Newport, Seattle, Kodiak, Cold Bay, Nomi, Kotzebue, and Barrow as well as other locations which may become necessary during the course of the Environmental Studies Program. Major offices of other data gathering agencies currently involved in the OCS program are in Washington, D. C. (DOT - USCG; EPA; NOAA - CEDDA, ESIC, NODC); Reston, Va. (GS); Asheville, N. C. (NOAA - NC C); New Orleans, La. (GS); Denver, Colorado (NOAA - NGSDC); and Menlo Park, California (G S).

Information requirements at various BLM offices can be expected to vary according to several factors including office responsibilities, state of the OCS lease program in their area of interest, lease area activity, the number and type of contract investigators, the mix of staff disciplines, and the scope of current environmental monitoring and research efforts. Further, the input/output hardware, stored data, and computational resources required to service requests from any BLM office, however remote, can conceivably vary from the most trivial requiring simple data extraction to the most complex involving the entire Data Management System and all of its accumulated data base.

The Data Management System necessary to solve widely varying demands by geographically dispersed offices must be completely flexible and capable of rapidly being reconfigured in the field. Not knowing the data and software requirements of each office a priori, it is necessary to provide all offices with the potential for using all Data Management System software and data base capabilities and temper its use of these elements by gauging its hardware to fit current processing and information volume needs. In this manner, a single software system and observation data base can be maintained with universal applicability.

7.3 Design Philosophy

In designing a Data Management System for the ELM OCS Environmental Studies Program one cannot consider each element of the system separate from all other system elements. No major component is separable. Requirements levied by the information needs of the users, and their geographic dispersion; the input flow of data; the computer system -- its computational capabilities, operating system and storage, data base management software; and functional processing programs must all be considered simultaneously. In keeping with this philosophy, outlined below are basic design objectives;

- A computer-based system available to all BLM users.
- Broad-based data storage, retrieval, computational, summary and modeling capability.
- Rapid response and at minimum turn around time.
- Easily interfaced to user prepared programs.
- Simple for users to learn and operate.
- Flexible modular design for adapting to new requirements.
- Computer hardware independence.

- Minimum maintenance.

7.4 Design Goals

Of paramount importance in the design of a large scale computer-based system, is to accurately define the needs of the intended user, both for the present time and the foreseeable future. Uncertainties in anticipating the future needs should be accounted for by providing a system structure with a built-in orderly growth capability. Flexibility is necessary to permit the system to adapt to changes in BLM requirements. This section defines some of the top level design goals which, although might be considered to have the importance of requirements, are not rigidly definable and are subject to trade-off considerations. It is a requirement to maximize the attainment of the following design goals:

- User Orientation

  The Data Management System design should attempt to minimize the effort required to learn and use the system. The user specification syntax should be as simple as possible.

- Flexibility

  Because of the broad requirements for the application of the OCS Data Management System, the system structure must be extremely flexible to respond to changes in user needs. The input command structure and modular design should provide the user freedom to exercise its spectrum of data handling and analysis capabilitiess with minimum operational ordering constraints.

- Program Modularity

  Functional modularity is essential to achieve the flexibility y and adaptability requirements of the system. The modular approach to software design and implementation enables the application of the building block concept and simplifies both development and verification.

- Program Expansion

  The Data Management System should be designed to be modifiable and expandable to handle new requirements without undue effort.

- **Use of Computer Memory**

  The System design should be such that only those capabilities specifically required by a user, as defined by input, are loaded into a computer fast access memory. This avoids unnecessary fast access storage usage and potentially reduces job turn around time.

7.5 Design Requirements

- **Computer-Based System**

  The Data Management System must be implemented on a computer-based system to provide rapid access to acquired environmental information.

- **Implementation of System**

  The initial implementation of the Data Management System should be achieved with a minimal effort insofar as the major data base management software system is concerned. The selection of major computer hardware and data base management system should be predicated on this compatibility.

- **Storage Capability**

  The System should have sufficient direct access and bulk storage with growth potential to accommodate all data from BLM environmental baseline and monitoring. Standard magnetic tape drives must be available to read bulk data acquired in the field and from other agencies.

- **R emote Capability**

  The Data Management System must provide ready access and potentially equal capabilities for data storage, retrieval, and subsequent analysis to all BLM OCS office facilities regardless of how remote they may be from a center of activity. Each facility should also have access to all data acquired by the system from supporting non-BLM agencies.

- **Interactive**

  The Data Management System desired should be conversational, interactive time- shared and have the ability to serve many users concurrently.

Each of these users must have the ability to explore all the data in the system without concern of other users in the system.

The ability to interactively query the data base provides the experimenter and model builder with the ability to change his strategy and to attempt several alternate modeling techniques within the span of a few normal working hours. Job turn around is minimized using this capability, resulting in a shortened model development time period.

- Batch and Remote-Batch

The ability to perform batch and remote batch processing must be permitted. In this manner, a user can postpone repetitious, lesser priority or large volume jobs to times which are convenient for the operating system rather than impose service constraints which may not be necessary under all circumstances.

- Standard Programming Languages

The host computer operating system must provide standard programming languages such as FORTRAN, COBOL, and PL/I (IBM) for users to employ in all modes of System operation.

- Processor Access

The Management System and host computer should be of such a nature that they have the capability to converse with other processors in support of the data retrieval function. With this ability, the data system supporting various field users is extended to several processors.

A multi-processor retrieval capability can be employed to acquire data currently stored in systems under NOAA such as the NODC file in Washington and the files kept in Denver. Such a capability would also be useful in acquiring information from the Geological Survey's platform inspection, production, and accident monitoring program in support of various impact determination studies. (The GS data is currently stored in data files at the Reston, Va. computer facility).

Data transfers via magnetic tape only present a snapshot of an external data base which is naturally subject to change. In the ideal situation, one would like to access information in a dynamic sense so that the information acquired for use represents the best picture of that archive at the instant BLM studies require it.

- **Availability of Processing Equipment**

  In its initial implementation, the computer required to service the Data Management System must be owned or operated by the government, readily available to a major BLM facility and have a current checked-out configuration which supports the OCS storage and remote system requirements.

- **Software System Convertibility**

  A priority consideration in the selection and development of a Data Management System is its convertibility. That is, its ability to be used on computer systems of various manufacturers with a minimal conversion effort. This implies that the data management system must either be written on a machine independent language or exist in multiple versions which are acceptable by the major computer manufacturers' standard, medium-to-large scale product line. Convertibility is important to reduce the potential impact of computer system conversions and, therefore, achieve a reasonable system longevity.

- **User Command Structure**

  Input commands to the Data Management System should be both fixed field and format free, providing the user with the ability to address the system in terms not constrained in word lengths, columns, or specific positions. This facilitates rapid user- system interchange and eliminates trivial errors.

  The most natural candidate language to be used for input commands consists of English-like statements. In this syntax, the Data Management System would provide the capability to distinguish various types of words including: commands, names, connective, and restrictors such as equal to, greater than, less than, not, or combinations of the above.

- **Discipline Oriented Commands**

The user should have the ability to address or query the data management system in terms consistent with his discipline. That is to say, using oceanographic terminology or terms consistent with the oil and gas field, for example. This requires that the data management system have the capability of translating user language into instructions which can be implemented by the data processor. Commands in processor language are in a form which address specific programs or the data base manager to acquire named files o r named variables within files. This Data Management System translation ability relieves the external user with the responsibility for program interface knowledge.

61 **Tutorial System**

The system should provide the user with a tutorial aid for accessing and using its capabilities correctly.

- **Multiple Job Step Capability**

The System must provide the capability for users to perform a series of data base manipulations and user designated computations within one job submittal.

- **User-Developed Programs**

The Data Management System must provide the capability for users to develop their own programs and access the data base through a well designed interface.

- **System Growth**

The analysis capability that will evolve to utilitize the collected OCS data will necessarily contain software programs of varying complexities for a wide variety of users. One must have a system in which developments at any user facility can be provided to all users. It is also desirable to take routines originated in other agencies or institutions and add them to the program library with a minimal interface effort. This last point concerning the acquisition of software makes it advantageous to seek a system which is not only in current operational status, but also is one under development by an existing agency or set of agencies. In this manner, a constant increasing capability will envolve for use by BLM.

- Experimental Program Maintenance

  The System must provide for the maintenance of programs which are in the development stage and used by specific users on an experimental basis.

- Gene ral Analysis Capability

  The Data Management System should provide a capability to perform a variety of statistical analyses in support of phenomenological model building. Numerous sets of programs exist throughout government or can be acquired from universities including such statistical program analysis tools as DATA TEXT (Harvard), SPSS (University of Chicago), STATPAC (GS), and BMD/BMDP (UCLA). The program library supporting the data management system should contain these tools or their equivalent which are accessible to the user through standard linkages. A flexible library of standard analysis routines should also be accessible through the computer operating system.

- Oceanographic Analysis Capabilities

  The System should provide access to standard oceanographic and correlation analysis procedures. It should also provide access to selected simulation models (such as the NOAA current model) in support of routine and special analyses.

- Socio-Economic/ Administrative Reports

  The ability to append various programs for socio-economic analysis and program administration to the basic system should be provided.

- Report Generator

  A general report generating capability should be part of the system.

- **Data Validity Checking**

The Data Management System must be provided a capability for verifying or validating environmental measurement inputs in accordance with reasonable norms or limits of parameter excursion. Data pas sing through such a routine should be flagged if found invalid so that knowledgeable investigators can take appropriate action.

In the infant stages of the data base, each set of data will undoubtable be scrutinized by BLM investigators for parameter reasonable - ness. However, as System use grows and the input data volume increases, this personal handling may not become feasible.

- **Bulk Data Loading**

The ability to bulk load data from tapes or files is required by the Management System to accommodate data which has been gathered in the field or transferred from other organizations. This capability is required to circumvent the expense associated with bulk data entries via on-line terminal.

- **Data Translation and Transfer**

The ability to reformat inputs from other agencies into standard data system formats should be provided by software modules developed for specific agency input. The ability to provide punched card and magnetic tape outputs to facilitate data transfers to other organizations is also required.

- **Metric Units**

The System should provide for the routine conversion of data base and computational inputs or outputs to an appropriate metric system measure.

- **Temporary Data Base Storage**

If a user wishes to modify the data in the standard data base to facilitate a specific investigation, he must be allowed this convenience, but the data cannot be recentered in the data base in its modified form. It is, therefore, necessary that the System provide the capability of constructing and storing individual users data bases on a temporary basis for use in subsequent investigations. This capability is very important to support conceptual model building activities in which a specific set of data is used repeatedly while developing algorithms which describe physical phenomena. It would not be prudent to require the data base system to continually retrieve this information from the standard data base.

- Demon stratable and Available

The data base management system* used by the OCS Data Management System must be demonstratably compatible with the intended OCS application and be available for immediate implementation.

- Installation and Maintenance

The data base management system selected for use must be easy to install and require minimum maintenance.

- Input/ Output System Optimization

The data base management system selected should be designed to minimize input/ output system requirements and, thereby, optimizing data transfer rates.

- Centralized Capability

The selected data base management system should provide a centralized capability to control the physical placement of data.

- Program Device Independence

The selected data base management system should provide user programs with hardware device independence. This is another attempt to minimize the potential impact of any computer system conversion should one be necessary during the life time of the system.

- Interactive and Remote Operation

The data base management system must be designed to facilitate interactive operation to system remotes through its own software interface or that within the host operating system.

---

* A glossary of data base managemen system terms is provided in Appendix F.

- File Management and Maintenance

The data base manager should provide adequate file management and maintenance procedures.

- System Maintenance Skill Requirements

The skill level and training required for data base management system maintenance personnel should be minimal.

- User Skill Requirements

Data base management system query logic and operation should be oriented to users which have minimum skill and training.

- Data Selectability

The data base management system should afford the user record selection techniques employing Boolean logic and permit the designation of any data element or group of elements as selection keys.

- Data Retrieval

The data base manager should provide the ability to retrieve whole records or partial records in response to user queries.

- Sort-Merge Capability

Retrieved data should be provided the user in key sort order. If data from multiple files are requested, the data base management system should present the retrieved data in merged sort key order.

- Hierarchical Structure

The data base management system should have the ability to utilize and maintain hierarchical data structures which permit the reduction of data storage requirements and facilitate rapid organizationally linked data retrievals. Some applications of hierarchical structure exist in biological sample taxonomy and the identification of measured data by tract location, platform location, investigator, sampling technique, cruise number, OCS area, and sample archive. It is undesirable to retrieve data of interest through a sequential file search. Hierarchical file structuring permits a reduction of this search process.

- **Inverted File Structures**

The data base manager should provide for the use and maintenance of inverted data files to provide for the rapid access of data items according to designated data keys such as tract number, geographic location, cruise number and investigator. These inverted files may consist of complete replicates of the original file in a different key sort order or, and most desirable from a storage standpoint, files of index pointers in key sort order which direct the data base manager to the data of interest within the master file.

File inversion always requires the redundant use of storage and the cost of subsequent inversions each time the data base is recreated; however, these costs are compensated through increased efficiency in data retrieval.

- **Catalogs**

The ability to construct and maintain catalogs or directories must be built into the data base management system. These catalogs permit the rapid screening of data bases in response to various queries without scanning an entire file for the specific parameters of interest.

Two types of catalogs are in general use: subject and inventory catalogs. In relation to the BLM OCS data base application, a subject catalog might contain descriptive material defining the various types of files maintained by the system. An inventory catalog, on the other hand, might contain the station numbers associated with data in which a particular bottom sampling technique was used, the stations at which mercury toxicity levels were measured, and the lease tracts in which active production is under way.

The catalog technique is used by the STORET system to facilitate the rapid response to inquiries which would ordinarily require a search of the complete data base whether inverted or not. A complete search is of no consequence with a small data base, but as the baseline measurement and monitoring program continues into areas other than the present MAFLA region, it will become quite voluminous. In this environment, the luxury of item by item searches cannot be maintained.

- Structure Transparency

Operations of the data base management system should be of sufficient simplicity to permit the user to store data into or access data from a data base without knowing its internal structure or influencing his commands accordingly. It must allow the user to interact with the data while being relieved of the mechanics of maintaining the structural associations which have been declared.

- Structural Versatility

The data base manager should allow data to be structured in the manner most suitable to each application, regardless of the fact that some or all of that data may be used by other applications. Such flexibility should be achieved without requiring data redundancy, The data base management system should also allow the declaration of a variety of data structures ranging from those in which no connection exists between data-items to network structures.

- File Definition Versatility

The ability to define any number of data files should be provided within the data management system. The OCS application requires several different types of files with differing file structures to accommodate base-line environmental data and data acquired from other agencies. Therefore, the data base management system must have parallel versatility.

- File Manipulation

The data base management system should provide a capability to manipulate files of various structure and merge files of differing lengths on common keys. It should not be necessary for the data base system to convert separately structured files into a one consistent file format before any manipulation.

- **Variable Length Records and Fields**

  The data base management system must be capable of storing the OCS data in records and fields which can be compressed to a minimum length and not require interspersed blank or fill fields to facilitate data storage.

  Environmental data acquired on the continental shelf will be variable in length by both design and happenstance. In some OCS areas, investigators may take several measurements of biological specimens, to cite an example; whereas, in other OCS areas or at other time periods investigators may not take any. It is therefore necessary that the environmental data file have the ability to be compressed so that it can contain the complete set of information acquired and nothing else. In this manner, the data file length is reduced to its minimum.

- **File Redefinition**

  As the OCS program progresses, it is conceivable that the environmental data requirements may expand or contract from that defined in the initial baseline study. This being the case, the ability to reflect these changes by permitting the expansion or contraction of the data file must exist within the data base management system.

- **Text Storage**

  The data base management system must permit the storage of text information with the data base without maximum length constraints.

- **Variable Data Content**

  The data acquired and stored in the OCS data base can either be numerical quantities, text information or combinations thereof. The data base management system must permit this variability.

- **Concurrent Operations**

  The data base management system should permit concurrent retrieve and update operations on a data base by more than one user.

- **Search Strategies**

  The data base management system should provide and permit the use of a variety of search strategies against an entire data base or portions of a data base.

- **Data Base Modification Capability**

  The data base management system should provide a capability for readily updating, deleting, and adding to existing data bases with minimal effort and without requiring the data base to be recreated. Modifications to existing data items should be made and maintained without destroying the original data until recreation. At that time, the original data base should be kept on tape in a back-up status.

- **Data Base Restoration**

  The data base management system should have the ability of easily being restored from back-up library tapes containing previous versions of the data base and tapes generated at periodic intervals during regular system operation.

- **Data Base Recreation**

  The frequency of necessary data base recreations should be kept to a minimum.

- **Search and Update Costs**

  The cost of searching and updating a data base should be minimized under the data base management system.

- **Storage of Processed Data**

  The ability to store processed data in a data base under control of the data base management system should be provided.

- **Data Base Description**

  The data base management system should provide a capability for describing a data base in a manner which is not restricted to any particular processing language.

- **Management System Architecture**

The data base management system architecture should be such that it permits the description of a data base to be accessible to multiple processing languages such as FORTRAN, COBOL and PL/I (IBM).

- **Program Data Independence**

Use of the data base management system should allow programs to be as independent of the data file structure as current techniques will permit, An individual programmer need not be concerned with the entire data base but only with those portions of the data base which are relevant to the program he is writing.

- **Data Base Protection**

The data base should be of permanent nature which can reside in various files and be protected against user alterations unless sanctioned by proper authority. Provision for protection against assess to proprietary data elements should be provided. This latter capability is applicable in manipulating files of well production kept by the GS.

- **Authority Pas swords**

The system should provide for a system of authority passwords to be employed as requisites for modifying the standard data base and purging user created experimental programs or data bases from the system when their utility, in the creator's estimation, is over. The use of authority passwords protects the standard data base from inadvertent destruction, limiting the modification of existing data bases to those responsible for that task.

7.6 Documentation Requirements

Thorough and well organized documentation is required which will allow for growth and convenient updating with emphasis on completeness and clarity. Four types of documentation are required:

(a) User's Guide

This contains a complete description of system capabilities including user input commands; data base management conventions; and application, computation and modeling subsystem functions with their input requirements and report outputs. It should also contain a brief description of the host computer hardware system and particulars concerning access techniques applicable to user's facility.

(b) Computational System Description

This document precisely defines the computational capabilities of each subsystem including the mathematical equations, algorithms, and rationale where appropriate. All pertinent information useful to the investigating scientist and applications programmer should be described including assumptions, limitations, and approximations used in the mathematical modeling; program structure; information flow; data handling and other special programming considerations. Flow diagrams and schematics describing these portions of the system should also be included.

(c) Executive System Description

This document describes the function, operation and maintenance of the executive software system for system maintenance personnel. It is" addressed to the intricacies of the user interacti on, execution supervision, and utility service functions of the system. Flow diagrams and schematics describing these portions of the system should also be included.

(d) Program Listings

An annotated source language listing of program elements should form the final system document. This should be structured to facilitate incorporating program modifications and updates as they occur.

8.0 ALTERNATIVE SYSTEM CONFIGURATIONS

The System developed from the requirements in Section 7 must provide its users with rapid access to all accumulated observation data through a sophisticated data base management system ope rating in conjunction with a spectrum of functional analysis and utility software. The ease of use and interaction between the various system elements is considered necessary to provide the user community with a capability to support their various model building and environmental impact ass es sment activities.

The System must also be open-ended to provide growth potential to accommodate the increasing need for the storage of data that will be accumulated on the outer continental shelf and for the information acquired from other agencies to supplement the environmental measurement data.

Through discussions with BLM on alternative approaches, a centralized facility with remote access from the field has been selected as the most appropriate. However, for completeness, a discussion on alternatives evaluated is provided in the following. Alternatives considered were:

(1) The decentralized use of compatible B LM mini-computer configurations.

(2) The decentralized use of BLM maintained computer configurations.

(3) The decentralized use of agency computers conveniently available to the OCS offices.

(4) The use of an existing system within another agency's facilities.

(5) The use of a centralized BLM facility through remote access terminals installed in the field.

8.1 Decentralization

General considerations which must enter into the decision process are those associated with the operation of a decentralized set of computer configurations. (We assume that decentralization implies that a computer will be located within the proximity of each regional office.) In a decentralized environment, each office must house system development, operational and maintenance staff; provide for the training of personnel; generate and supply operations documents to its users; coordinate, acquire and translate information from other federal and state government agencies; and generate all necessary reports which require access to its data base to satisfy needs expressed by the local office and BLM headquarters. Each office would have to be responsible for system and data base updating. Software development and exchange between decentralized units would be on an ad hoc basis requiring the diligent efforts of all responsible regional staff members.

Having computer configurations in regional office sites would not relieve BLM OCS headquarters from maintaining their own system to supply an analysis and report generating capability based upon information not available at regional offices or extracted from reports produced in all regional facilities. Investigators under contract to headquarters or regional offices would have to access data at those sites by direct methods or through remote terminals. This would ultimately result in a prolifer - ation of systems that would be very difficult to maintain in a compatible mode. In effect, a decentralized system would approximate the situation that currently exists throughout government with respect to the maintenance of environmental data systems. To cite a recent (November 22, 1974) survey report by the Comptroller General regarding problems associated with environmental data management s ys terns:

> Noncompatibility of Data
>
> Discussions with various systems managers revealed that the manner in which environmental data is coded in the various systems hampers or prevents its exchange. Data is collected for a single purpose in one type of coding arrangement, and it is difficult to use that data when it is

transferred to other systems having different codes. To overcome this problem, some managers have indicated that they must recode the data received from other sources according to their own individual system's configuration before the data can be used.

Data Unreliable

Some managers indicated that the accuracy and reliability of data generated by other systems constitutes a problem. One system manager commented that no uniform standardization or degree of accuracy for data exists -- nationally or internationally. He made the further observation that once data is received from other systems, one must have an indication as to how often the equipment collecting the data is checked for accuracy.

Hardware Noncompatibility

There is a variety of manufacturers of computers and associated equipment. Although the concepts used to store data and programs on this equipment are similar, the actual methods used are sufficiently different to preclude direct interchange. For example, some managers said that the format in which data is stored on magnetic tape can vary and prevents direct exchange of tapes between systems.

Software Noncompatibility

Because there are many different computer program languages, there are differences both in the manner in which programs are written and in the manner in which data is processed and stored. Consequently, data recorded by a computer using one language may or may not be directly usable to a program written in another language. For example, a manager using a UNIVAC 1108 indicated that his system used certain levels of the FORTRAN language and that his system could use data directly from another system only if it used the same FORTRAN version.

8.2 Mini- Computer Configurations

Data base management applications on mini-computers are limited because they are generally processor bound and cannot maintain the peripheral facilities required for data base management. The small word lengths generally associated with mini-computer hardware make scientific computations difficult and mini-computer configurations are not usually equipped to perform the necessary unit record tasks such as providing large volumes of hard copy outputs at reasonable speeds, card-to -tape operations and data preparation. Lastly, mini - compute rs generally do not have fast access memory sufficient to provide storage for operating software, a language compiler or a data base application program, assuming a data base manager of necessary sophistication could be acquired which will work in the mini-computer environment.

8.3 B LM Maintained Regional Computer

A regional stand-alone configuration based upon the use of a small-to-medium s tale, general purpose compute r would ultimately result in a substantial investment at each site in order to supply the capability required by a regional data base and supporting peripheral service devices. The system must contain on-line magnetic tapes for bulk data inputs /outputs and sufficient disk capacity to provide a ready store for the environmental data to be acquired by its users. The system must also have an on-line hard copy printer, a card read/punch station, on-line interactive terminals to facilitate inputs to the system, displays for viewing data retrieved from the data base, and a digital plotter for providing required graphic outputs generated by the system functional software.

The decision to acquire a full computer system for an office that may not avail themselves of its capability for some period of time exceeding a few months is not economically rational. Although a "stripped" system could be acquired to support the regional effort during the initial stages of OCS program development within its area of interest, a progression of incremental capability increases would be necessary to construct a system sufficient to support the program when many investigate rs are contributing data to its data base and manipulating its content. By the nature of this incremental growth, several software system modifications and conversions would be necessary to maintain a capability usable by its investigator community. These conversions require manpower and time to accomplish. It also necessitates an investment which, unless compatibility is maintained between BLM OCS regional offices, will be lost. Software development efforts cannot fully be amortized unless these developments are made available to many users. The required investments in equipment and supporting staff negate this alternative.

8.4 Use of Convenient Regional Facilities

Another alternative would be to permit each OCS office to procure time on a computer system that was convenient to them, While this strategy permits an individual office to rapidly come on-line and be capable of various computations with very little start-up time and costs, the problems ass ociated with providing each office a compatible capability are multiplied immensely unless a data base management system and functional software is selected so that they readily fit in systems available to all OCS offices with minimal effort.

In the long run, this strategy is also expensive since it requires additional system staff at each regional office which are knowledgeable in the use of several computer systems and configurations. Once selected, there is no guarantee that a convenient computer will always remain so. Computer configurations are constantly being changed and the regional staff may routinely have to "shoehorn" their software into new compute r systems. These occasions may be frequent since host systems probably will not be under BLM control. Each region can be expected to suffer from this problem if this strategy is selected.

8.5 Use of Non-BLM System and Facility

Another alternative is the use of existing hardware and software system at another agency's facility. While this option is believed to be viable during the infant stages of the BLM program if constrained to a short term utilization, the intended use of this arrangement, however, is not one which the BLM OCS program should support. The reason being that as the OCS requirements for software and data base capability exceed those of the host system, some accommodation will have to be made either through a change of OCS direction or an interagency transfer of funds to facilitate a system modification. In either case, the response to requests for change will not be comparable to response times offered B LM staff trained in system maintenance. Management and policy problems associated with interagency service agreements are not easily resolved at the working level and often require interaction between agency principles whose time far exceeds the importance of the policy in question. This arrangement cannot be responsive to BLM user's changing needs. However, it does present a short term utility during the checkout and implementation of a B LM dedicated s ys tern if that utilization is channeled in such a way that it is compatible with later program developments.

8.6 Centralized BLM Facility with Remote Access

The last alternate to the above strategies (the selected approach) is one in which a centralized facility is defined for the entire OCS Environmental Studies Program and that facility provides the staff and a large-s tale data proces sing computer with operational software and a data base management system for use by all OCS participants in the field through dial-up or leased-line remote terminals, providing them with the ability to remotely execute batch or interactive programs.

The advantages of this strategy are many-fold. A single data base management system can be selected to serve all regional field offices. Functional software can be developed and access to these systems can be provided for all users. As the inventory of functional software increases through contributions from all participants, both at the centralized facility or at regional offices, the entire user community benefits from these developments. A centralized distribution of software documentation describing the operational system can be defined, distributed and maintained by a single staff. Regional office staff requirements can be minimized by concentrating all data base administration, management and system maintenance personnel in the centralized facility. Regional operational staff can also be reduced through the use of minimum operation remote systems. If the data base management system is selected with the user community as its objective audience, data base manipulation can be performed by the s cientist-investigators thems elves with limited training provided through centrally distributed operational literature.

Regional facilities need only support those hardware systems sufficient to provide them with the computational capabilities they require in their current and immediate-future mode of operation. If a regional facility need only access the data base for a minimal number of inquiries per day generating outputs refined in terms of a few dozen pages, these accesses can be made to the data base through a selectric typewriter remote. On the other extreme, if the required data base manipulation approaches the point that many users at the regional facility create an output which necessitates the installation of an on-line printer, this can be a reasonable expenditure since the cost of the increased service is borne by a group of users. So also would be the acquisition of supporting remote displays, plotting devices and the lease of high bit-rate communication line if a justification were made on the basis of an established user community. Equipment could also be transferred from one region to another if a shift in workload demanded such a change.

Extreme flexibility is provided by this option. Not only can a regional office guage its hardware configuration to meet its current data flow requirements, it can also act as a satellite center for the various research/investigators sponsored by that office who operate on the data base through a minimal level remote in their facility. When bulk data input/output requirements are necessitated by their particular investigation, they can direct those inputs or outputs to a regional facility which has a larger, more capable remote configuration. A network of satellite remotes can be accommodated within this concept.

It is believed that the concept herein described and pictorially shown in Figure 8 '1 provides the most cost effective, open-ended capability that can be acquired to support the BLM OCS program. It is this basic configuration that will be used to support the data base management-functional processor concept to be described in the following section.

It should be added that several data base management systems currently used for oceanographic or water quality data have been developed for large scale systems such as the CDC Cyber 70, IBM 360/370, and Univac 1100 series computers. By maintaining compatibility with the processing requirements of systems at this level, the BLM OCS program can avail themselves of software that has been developed and checked out to the sufficiency of the generating organizations. This wealth of software, potentially convertible to the BLM OCS system, provides another inducement for adopting this type of computer configuration.

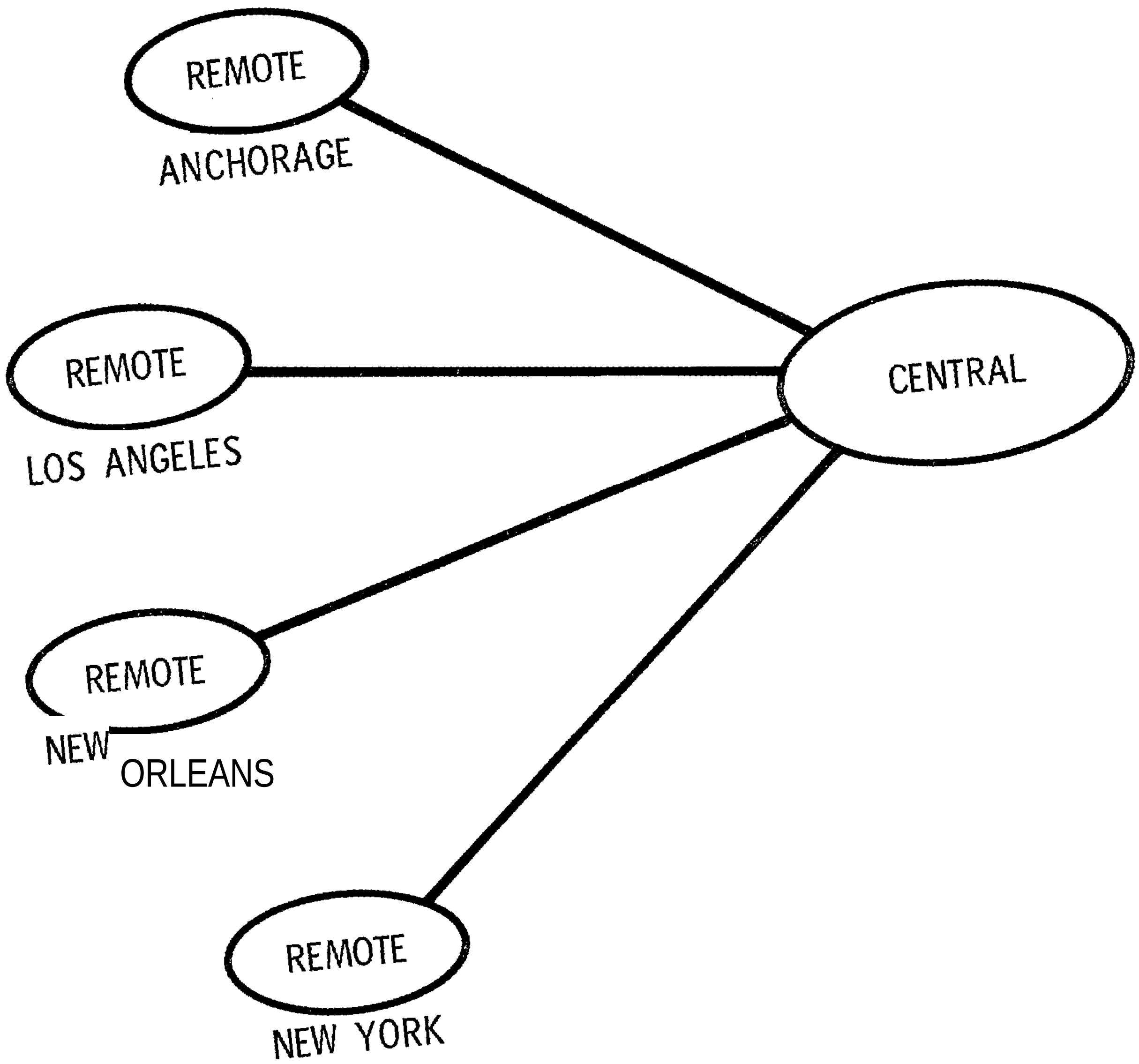


FIGURE 8-1. **Functional REMOTE CENTRAL COMPUTER CONFIGURATION**

9.0 SYSTEM CONCEPTUAL DESIGN

The Data Management System design proposed in this section assumes a computer hardware environment in which all users have access to the data base either by direct batch mode methods or through a remote terminal. The design does not presume a computer hardware capability beyond that gene rally available within the medium-to -large s tale government ins tallations unde r investigation. Additions to that hardware which the implementation may neces sitate are addres sed in a following section. A similar treatment is applied to the data base management system. The necessary sophistication of that system and the immediacy of its need imposes the requirement that the system be selected from those currently available and operational. The evaluation of likely data base management system candidates is also supplied in a section to follow.

9.1 Basic System Design

The scientific, exploratory nature of the B LM OCS Environmental Studies Program involving many sources and types of data from various geographic locations (see Figure 9-l), imposes the requirement for a computer-base data management system which has the following characteristics:

(a) Facilitates the use of a general data base management system.

(b) Provides a broad-based, open-ended computational and modeling capability.

(c) Easily adaptable to new requirements.

(d) Provides a flexible application of capability.

(e) Efficient to operate, and quickly learned.

(f) Simple in structure and straight forward to implement.

The proposed concept which has been developed to provide such a capability lies in the design of a system of functional and utility processing programs, related to individual analysis needs, linked together by interface logic and controlled by an executive program that will allow users to exercise those processors in whatever sequence that is necessary

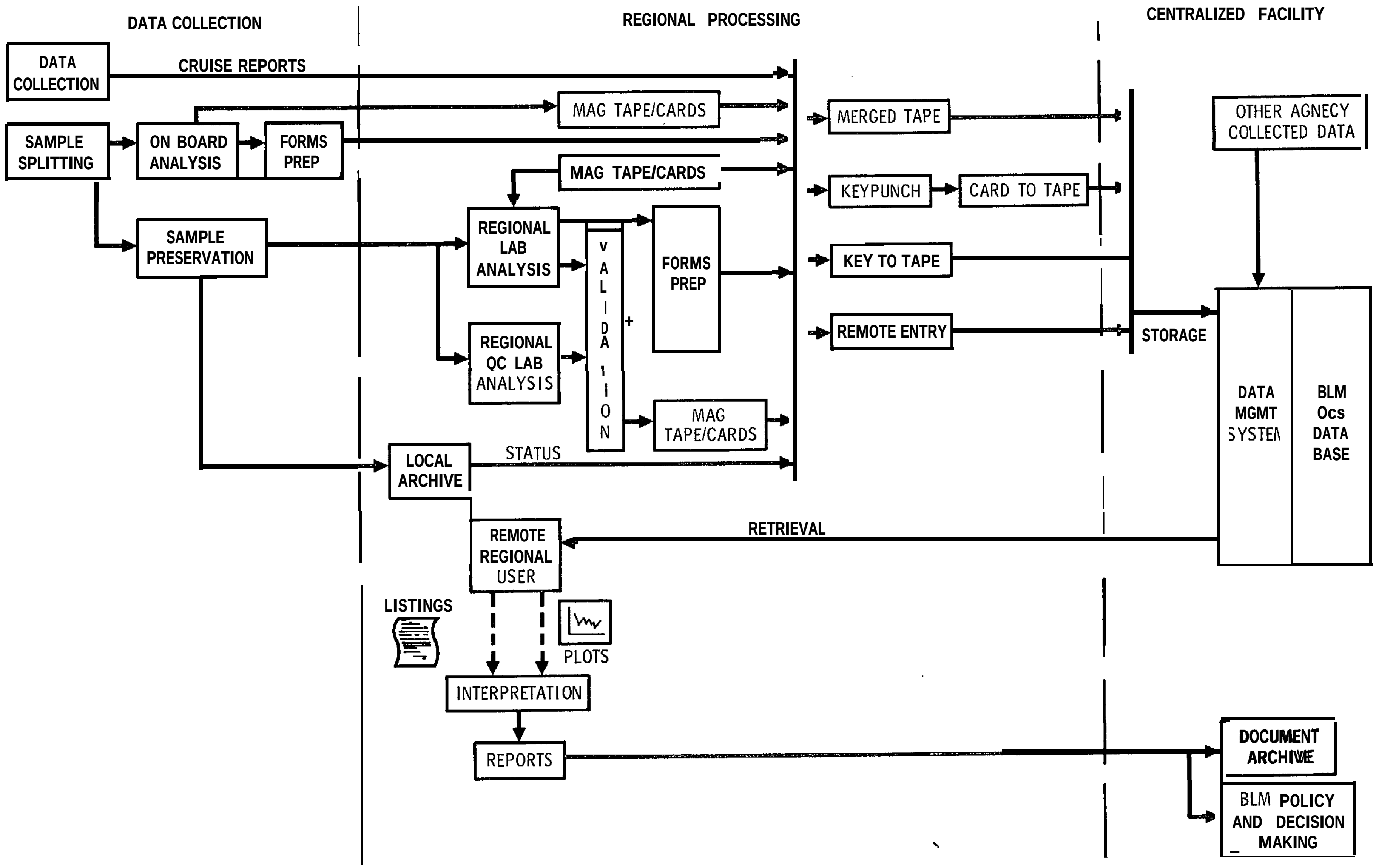


FIGURE 9-1. DATA FLOW

to satisfy the requirements of any particular study activity. System elements proposed to accomplish these tasks are the following:

- User Specification Processor
- Exe cution Supervisor
- Utility Processor Library
- Functional Processor Library

Each of these elements will be described below.

9.2 Executive Control Capabilities

The executive control portion of the proposed system consists of three primary elements:

(a) The User Specification Processor

(b) The Execution Supervisor

(c) A library of Utility Processors

9.2.1 User Specification Processor

The User Specification Processor has the function of interpreting the user oriented input specifications and translating them into a sequence of commands to be executed by the Execution Supervisor. Input specifications enable the use r to utilize elements in the library 'of utility and functional processors to construct a procedure for performing a desired study or analysis.

The specific functions of the User Specification Processor are:

(a) Reads and translates use r oriented specifications into a format compatible with internal requirements of the data management s ys tern.

(b) Performs error detection and diagnosis of the input syntax.

(c) Constructs linkage to the Execution Supervisor defining the sequence of Functional and Utility Processors defined by user input specification.

9.2.2 Execution Supervisor

The" Execution Supervisor is that portion of the Executive Program which is responsible for executing the utility and functional processors defined by user input specifications. Functions of the Execution Supervisor can be fulfilled by machine independent software in combination with services of the host computer operating system.

The Execution Supervisor performs the following functions:

(a) Retrieves designated processors from the library.

(b) Loads and controls the execution of processors.

(c) Monitors the execution of processors to detect errors during execution and provide diagnostic mes sages.

(d) Returns execution control to the User Specification Processor.

9.2.3 Utility Processor Library

The Utility Processor Library is a library of complete programs and subroutines which serve the needs of a large class of user applications.

Utility Processors perform the following functions:

(a) Data Base Management - provides a capability to accomplish the storage, retrieval and management of data located on external storage devices (disk or tape).

(b) Report Generation - provides the ability to produce report outputs of prescribed formats from designated data files.

(c) Statistical and Mathematical Computation - a spectrum of programs and subroutines which provide the ability to perform classical analyses on data within specified files. Included within this capability are bivariate and multivariate statistical analysis tools -- correlation, regression analysis, hypothesis testing, and analysis of variance ;estimation; numerical techniques -- interpolation, cliff e rentiating and smoothing; etc.

(d) Physical Unit Transformation - provides a capability for converting data defined in a specified system of physical units to another (such as, from English to metric units).

(e) Graphic Presentation - provides a capability to perform various two-dimension digital plots of data on standard grids or grids defined by the content of auxiliary data files. The ability to perform data contouring and automatic scaling is included within the utility processor graphic package.

9.3 Functional Processor Library Characteristics

The proposed Functional Processor Library consists of programs which serve the needs of specific analyses, performing computations in support of resource analysis, impact evaluation or program administration tasks. Outlined below are some info rmation and investigation areas to which functional processors might be addressed.

Program Administration:

- Baseline and Monitoring Schedule
  - Region
  - Phase
- Financial Reports
  - Subcontract
  - In-House
- Periodic Status Reports
  - Software Development
  - Data Collection
  - Data Analysis
  - Date Base Entry
  - Sample Archives
  - Leasing
  - Drilling
  - Production
- Support Equipment Logistic Reports
  - Personnel
  - Ships
  - Instrumentation
- Platform Inspection Reports
- Socio-Economic/ Land Use Reports
- External Service Request Reports
- Bibliographies

T ethnical Evaluation:

- Cruise Report Summary
- Periodic Gross Count Inventories
  - Listings and Plots of Current Data Coverage
    - By Tract Area
    - By Data Category/Amounts/ Locations /Seasons
- Periodic In-Depth Inventories
  - Listings and Plots of Selected Data Types
  - Listings and Plots of Statistical Analysis Outputs
    - Minimum and Maximum Values
    - Means
    - Standard Deviations
    - Trends
    - Cross Correlation Indices
    - Interpolation and Extrapolation
  - Listings and Plots of Standard Oceanographic Parameters
    - Sound Velocity (Wilson)
    - Shannon-Weaver Species Diversity Indices
    - Morosito-Ono Faunal Affinity Indices

Special Studies:

- Seasonal Currents
- Tidal Movements
- Transient Flow (severe weather)
- Air Sea Interactions
- Pollution Circulation Patterns
- Sediment Distribution
- Migration Patterns of Marine Organisms
- Nutrients Framework, Replenishment
- B enthic Structure
- Seismic Activity Patterns
- Platform Contaminants
- Marine Organism Uptake, Reproduction, Mortality
- Toxicity
- Level of Health

- Oil Spill Dispersion and Effects

9.4 System Element Interaction

The system element interaction is illustrated in Figure 9-2. A remote or batch user addresses the system User Specification Processor through a teleprocess or batch controller -- standard computer system software capabilities. The Specification Processor translates the user's task commands into a format compatible with the internal Data Management System requirements, examines this translation for possible syntax errors and, finding none, constructs a table prescribing the sequence of processors required to fulfill the specified task and links (or transfers) to the Execution Supervisor.

The Execution Supervisor retrieves the first processor designated in the table, loads it into memory and transfer control to it. During execution, it monitors the processor's performance for errors. Once completing the task, the Execution Supervisor loads the next processor in sequence, and so forth until all of the required processor tasks in the table have been executed. At that time, it returns control to the Specification Processor which continues to translate user task commands until it too finds its list exhausted. Control is then returned to the teleprocess or batch controller which accepts the user's LOG OFF and begins processing the next job in its queue.

9.5 Experimental Processor Development and Execution

Experimental Processor development and execution are illustrated in Figure 9-3. A user request for a text editor, interpreted by the teleprocess or batch controller, initiates a controller call for the editor. The text editor scans user supplied compiler language for syntax errors and directs the assembled language to a language compiler. This, in turn, compiles the text and stores the compiled object program in a temporary library file. The compiler then returns control to the teleprocessor batch controller.

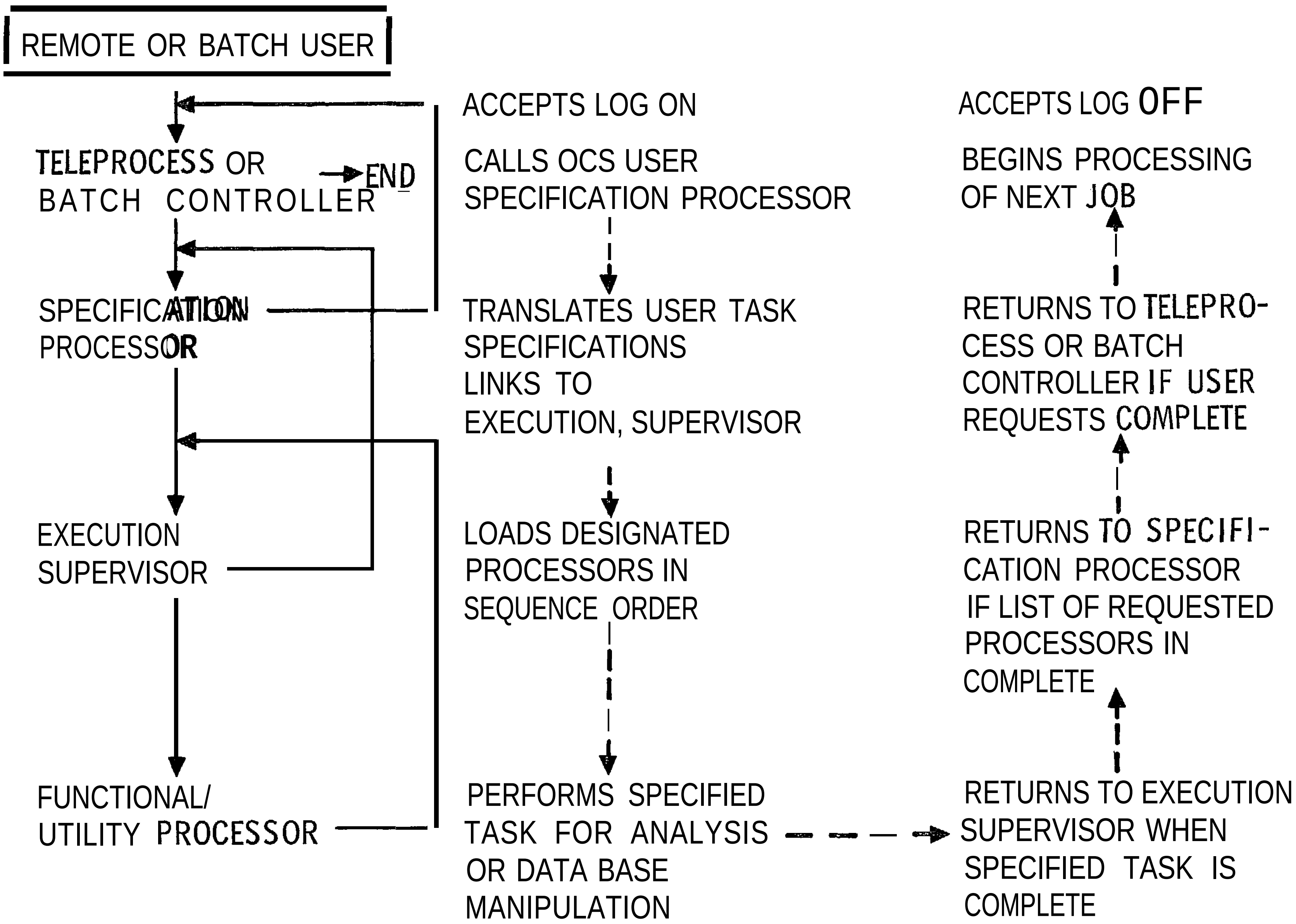


FIGURE 9-2. SYSTEM ELEMENT INTERACTION

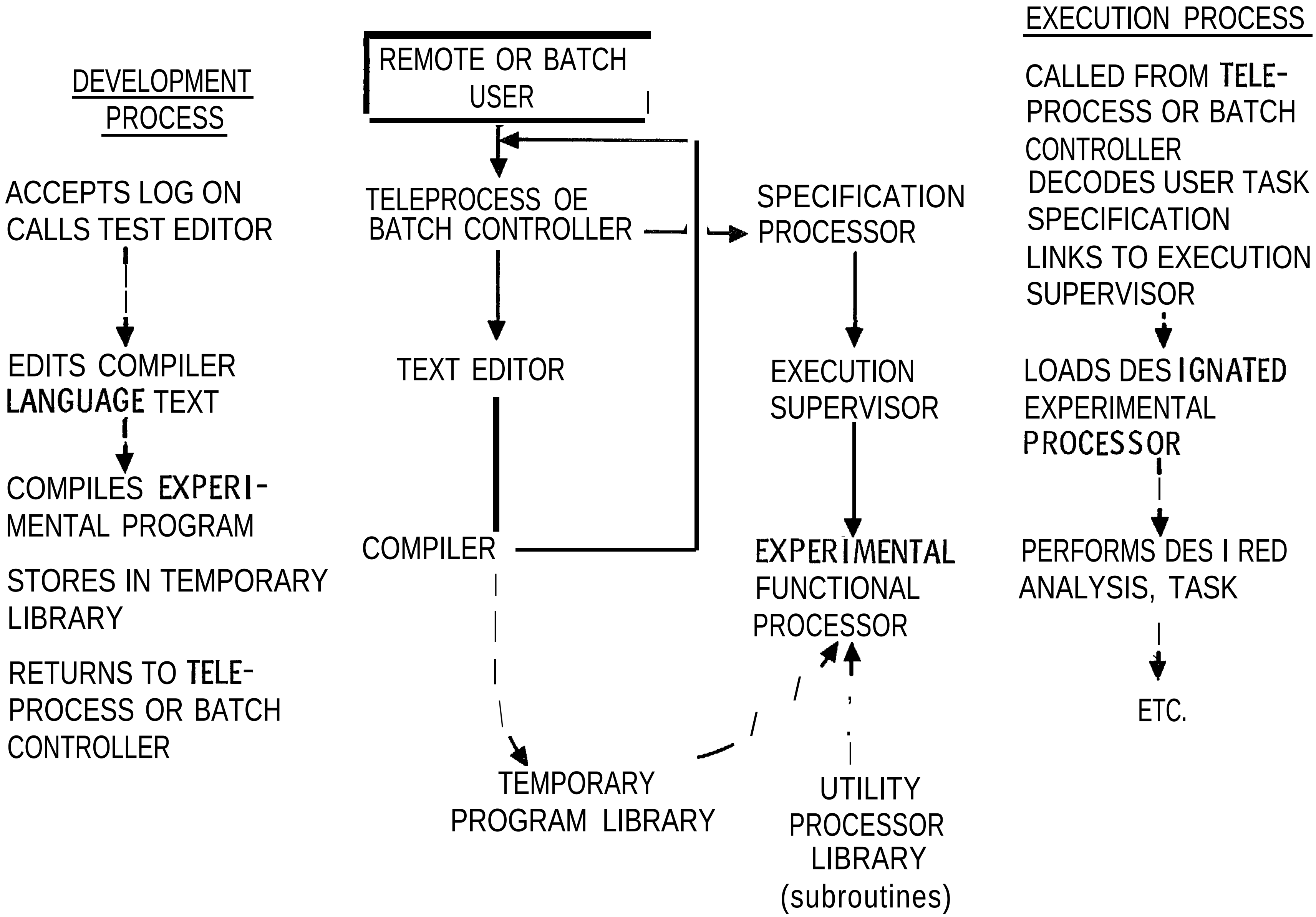


FIGURE 9-3. EXPERIMENTAL PROCESSOR DEVELOPMENT/EXECUTION

In a subsequent pass, the user requests the Specification Proces sor and presents it with a command designating the experimental processor previously compiled. The Specification Processor translates the command and links to the Execution Supervisor which loads the des ignated processor and initiates its execution. During the loading phase, the experimental program is augmented by specified subroutines from the Utility Processor Library.

It is assumed that processor elements will be programmed in a machine independent subset of a general compiler language. Programming guidelines for these processor developments are:

(a) Use variable names which closely correspond to actual problem variable names.

(b) Use existing (checked out) subroutines whenever feasible.

(c) Make the design facilitate checkout procedures.

(d) Minimize machine dependent programming.

(e) Design input scheme to relieve user of unnecessary effort.

(f) Locate 1/0 in one general part of the program.

9.6 Multiple Task Proces sing Capability

The OCS Data Management System's multiple task processing capability is illustrated in Figure 9-4. For each user input specification, one or more tasks may be initiated depending upon the level of user command language complexity. In the illustration, a single user input command specification defines four tasks which are performed in sequence under the control of the execution supervisor.

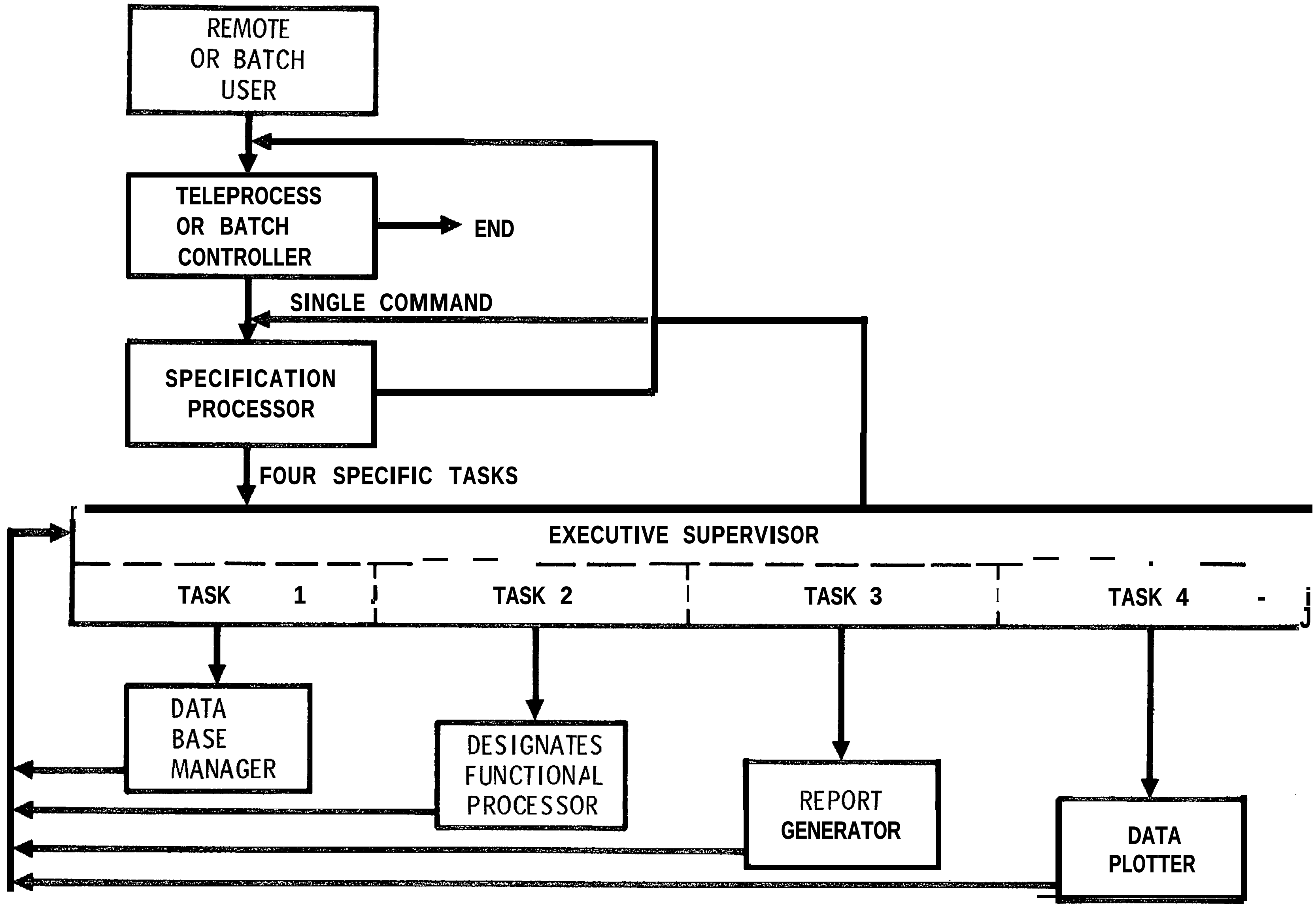


FIGURE 9-4. MULTIPLE TASK PROCESSING CAPABILITY

10.0 RATIONALE FOR SELECTION OF SYSTEMS INVESTIGATED

As stated previously, the Data Management System task of the OCS Environmental Studies program was to "define and document a basic data management system for the orderly flow of information between data collectors, analysts, and the program decision makers." Further, the effort was to

"design the system to be compatible with:

(1) Existing government owned/leased proces sing equipment that is available to the OCS Environmental Studies Program, and

(2) Other software programs /routines that have been developed for processing or analyzing similar data."

The system conceptual design outlined in the previous section was proposed to satisfy OCS Data Management System requirements as interpreted by the study, defined within Section 7 and directed by the centralized processor concept discussed in Section 8. This section, and those immediately following, candidate hardware and software s ys tern components are examined for their ability to fulfill BLM OCS requirements within the conceptual framework.

With respect to proces sing equipment selection, the Automatic Data Proces sing B LM Coordination (ADP) Office provided the priority ordered list of potential system host computers which follows. Processors are to be selected from:

(1) Equipment owned or operated by B LM;

(2) Equipment owned or operated by DOI;

(3) Equipment owned or operated by other governmental agencies;

(4) INFONE T System (operated by the Computer Sciences Corporation under GSA contract); and

(5) Commercial equipment.

Under the first category, the B5500 computer system used by BLM in Denver, Colorado is the only active candidate. In the second category, the two IBM systems (360/65, 370/155) operated by GS in the Washington, D. C. -- Reston, Va. area are the prime candidates, followed by the Bureau of Mines 135500 in Denver and the Bureau of Reclamation Cyber 74/28 in Denver. The assessment of non-DOI computers was limited to an investigation of the IBM 360/65 operated by the DOA in New Orleans, La. The DOA machine is currently being used by BLM for their post-sale bonus bid analysis activities in connection with OCS lease tracts.

In interpreting the contractual direction for software program compatibility, the tact chosen was to divide the investigation into three parts: existing total system capabilities, data base management systems, and functional software. Total given detailed examination were those which are currently used for environmental, particularly oceanographic, data by private institutions and agencies of the government. Data base management systems explored were those within previously examined data systems in addition to general systems currently owned or used by governmental agencies. Functional software examined were programs presently part of larger environmental data systems, available from the Geological Survey, and those cataloged by NODC and available from various universities and ins titutions. By dividing the software evaluation into three parts, all possible uses of present system software could be evaluated in proper prospective.

The total environmental system investigation examined the Gulf University Research Consortium's EDMPAS system, the Environmental Protection Agency's STORET system, operated by the Water Quality Branch in Washington, D. C. , the National Oceanographic Data Center system, and the Westinghouse UBSDB system.* The investigation of general data base handlers considered components of the above system and the TRW developed

* Summaries of a larger class of data management s ys terns are included in the Appendix C.

information management system GIM; the GIPSY system, written by the University of Oklahoma and used by the Geological Survey at their Washington/ Res ton facilities; the IBM inf o rmation management system IMS; and the MRI Systems' data base management capability SYSTEM 2000 which has been purchased by the Environmental Protection Agency and the Geological Survey Water Resources Division for ground water data management.

In addition to the systems outlined above, consideration was also given to a cooperative interagency sponsored plan under CEQ, EPA, and GS for the development of BIO-STORET using SYSTEM 2000 as a data base manager. Special purpose programs such as the BLM CRIS program were not considered in this study because of their limited transferability.

The s election of a limited subset of the environmental data s ys terns used in government was made on the basis of applicability to the intended BLM OCS Data Management System, given the general choice of computer hardware configurations. Without restricting the evaluation to the realm of rationality, the task could conceivably go on forever. To illustrate this point, attention is directed to a recent (November 22, 1974) report on the subject of federal environmental data systems by the Comptroller General of the United States to the House of Representatives, Committee on Merchant Marine and Fisheries, Subcommittee on Fisheries and Wildlife Conservations and the Environment. This report stated that, "many federal department and independent agencies collect and store environmental data, "and" [in] many instances, the information is collected in the same functional areas, such as air and water . . . . ." Some 220 environmental data systems used by 8 major departments and 10 independent agencies were defined by the Comptroller General's Office which observed that

> The environmental data systems appear to have been developed independently of each other to meet the specific missions of the various organizations . . . . . the Federal government has no central focal point for coordinating the establishment of environmental data systems or for exchanging or collecting environmental data 0

While not eliminating existing duplications of effort, the s ys tern proposed for the B LM OCS Environmental Studies Program will attempt to provide a path for data collection and exchange between agencies.

11.0 HARDWARE SYSTEM ASSESSMENT

Seven computer hardware systems were identified for potential utilization by the OCS Data Management System in accordance with BLM direction and rationale presented in Sections 8 and 10. These systems were:

(1) Burroughs 5500 operated by the Bureau of Land Management in Denver, Colorado;

(2) Burroughs 5500 operated by the Bureau of Mines in Denver, Colorado;

(3) Control Data Cyber 74/28 operated by the Bureau of Reclamation in Denver, Colorado;

(4) IBM 360/65 operated by the Geological Survey in Washington, D. C.;

(5) IBM 370/ 155 operated by the Geological Survey in Reston, Virginia;

(6) IBM 360/ 65 operated by the Department of Agriculture in New Orleans, Louisiana; and

(7) INFONET Univac 1108 operated by the Computer Science Corporation under GSA contract.

In this section, the application feasibility of these systems is examined. * System conditional acceptance is based upon the system's present configuration which should currently support teleprocessing applications; potential storage as indicated by the presence and capacity of on-line disc, drum, and magnetic tapes; present and long-term availability as indicated by current work load; accessibility for BLM applications and expected longivity. All of the material presented herein was acquired from interviews with responsible personnel associated with each installation or from a member of an IBM team that is currently under contract to develop a unified Department of Interior data proce ssing plan.

---

* Peripherally, the feasibility of utilizing ARPANET was also examined, but this alternative was rejected because of its membership and contract requirement uncertainties wherein a user must supply his own terminal (TIP) and purchase execution time and data storage from one of the private network host computers. (Government host computers seem inaccessible.) Current policy is expected to change in July 1975, when the net is transferred to the Defense Communications Agency.

11.1 Bureau of Land Management Burroughs 5500

The BLM B5500, whose configuration is outlined below, is considered unacceptable for the OCS Data Management System application because of its present batch mode operation and the planned system replacement in January 1976. This planned reconfiguration was considered necessary because the B5500 is not an efficient machine for computation oriented programs, graphics and line/point data plot applications; has no communications handling capability; and does not have removable mass storage for hardware/ software support. The new facility has been scoped to accommodate a remote batch terminal in the four OCS regional offices and in Washington, D. C. in accordance with recommendations offered in a 1974 BLM study. In view of the BLM allocation of data processing resources for OCS (approximated at 10% of their $700K budget), the new Denver facility is a viable choice for the installation of the OCS Data Management System.

B5500 Configuration

- BATCH MODE operation.
- Architecture: (1) Main processor (CPU), (2) 1/0 channel processors.
- Main memory: 196 thousand bytes of core memory.
- Auxiliary memory: Disc (2) EU (96 million characters, total).
- Magnetic tapes: (6) 7-track (200/556/800 bytes per inch).
- Line printers: (2) 1049 lines per minute.
- Card readers: (1) 1400 cards per minute.
- Card punch: (1) 300 cards per minute.
- Configuration change plans: RFP to replace system due to be released April, 1975. Replacement of undefined manufacture to be installed January, 1976.

11.2 Bureau of Mines Burroughs 5500

The Bureau of Mines B5500 configuration, outlined below, is considered unacceptable for the OCS Data Management System because of its extremely short term usefulness -- the system is to be replaced July-August, 1975.

B5500 Configuration

- Supports remote teleprocessing operations through a B472 or B473 communications processor.
- Architecture: (2) Main processors (CPU), (3) 1/0 channel processors.
- Main memory: 196 thousand bytes of core memory.
- Auxiliary memory: Disc (2) EU 196 million characters, total).
- Magnetic tapes: (12) 7-track (200/556/800 bytes per inch).
- Line printers: (1) 900 lines per minute, (2) 1049 lines per minute.
- Card readers: (1) 1400 cards per minute.
- Card punch: (1) 300 cards per minute.
- Configuration change plans: System to be replaced July-August, 1975 by a machine of undefined manufacturer.
- Comments: BLM has an interest in the machine and accounts for approximately 1/ 3 of its use (night shoft).

11.3 Bureau of Reclamation Control Data Cyber 74/28

The Bureau of Reclamation Cyber 74/28 is a fairly new machine, having been installed for approximately one year. Despite its newness, it is currently heavily committed to its present mission and users, so much so that its storage capacity is being increased. Future use of the system for OCS seems doubtful. It is, therefore, rejected as a candidate for the OCS Data Management System.

Cyber 74/28 Configuration

- Model 28 internal configuration containing the equivalent of (1) CDC 6400 and (1) CDC 6600.
- Supports teleprocessing operations through 12 channels and 20 peripheral processors.
- Services 1,2-15 remote job entry DATA 100/75 terminals and 100 DATA 100/73 dial-up, low-speed terminals.
- Main memory: 131 thousand words of core storage and .5 million words of extended core storage.

- Auxiliary memory: Disc: 20 drives (2. 2 billion characters, total).
- Magnetic tapes: (2) 7-track (556/800 bytes per inch) and (6) 9-track (800/1600 bytes per inch).
- Line printers: (3) CDC 512 (1200 lines per minute).
- Card readers: (2) CDC 405 (1200 cards per minute).
- Card punch: (1) CDC 415 (250 cards per minute).
- Configuration change plans: Planned 50-100% increase in auxiliary storage capacity.
- Comments: BLM uses machine through a remote terminal system designated as overflow machine for all Denver-based agencies. Heavily committed to its present users.

11.4 Geological Survey IBM 360/65

The Geological Survey's IBM 360/65 has all the computer hardware teleprocessing and mass storage attributes desired for the OCS Data Management System. It is currently used for only two-shifts per day (16 hours). This situation may change when it becomes a DOI service machine, but a size estimate of the potential increased load is not available to temper this judgment.

IBM 360/ 65 Configuration

- Supports teleprocessing operations through (1) Memorex 1270 terminal controller under HASP and TSO.
- Services 50 remote terminals including DATA 100/70, DATA 100/78, Data Point, HERTA, IBM 2741, IBM 2780.
- Tied to 9600 Baud leased lines to Menlo Park, California; Denver, Colorado and Reston, Virginia (to the GS IBM 370/155). Capable of executing programs at the command of the GS IBM 370/155 at Reston.
- Main memory: 4 million bytes of core storage.
- Auxiliary memory: Disc IBM 3330-24 spindles (2. 4 billion bytes, total), IBM 2314 - 16 drives (. 47 billion bytes, total).
- Magnetic tapes: (2) 7-track (556/800 bytes per inch) and (8) 9-track (800/ 1600 bytes per inch).
- Line printers: (3) IBM 1403 (1100 lines per minute).

- Card readers: (1) IBM 2501 (1000 cards per minute).
- Card read/punch: (1) IBM 2540 (Read: 1000 cards per minute-Punch: 300 cards per minute).
- Configuration change plans: Current plans are to replace (8) IBM 2314 disc drives with (8) IBM 3330 spindles.
- Comments: Currently running a two-shift operation with approximately 70% batch and 30% remote jobs. Will become a DOI service center machine July, 1975.

11.5 Geological Survey IBM 370/ 155

The Geological Survey's IBM 370/ 155 presents a mixed picture of potential capability. The present machine is heavily committed, so much so that GS has proposed an extension of the system -- another IBM 370/155 (outlined below). This large reservoir of computing power with all attributes required by the OCS Data Management System has a degree of uncertainty associated with it, however, in that the current system may be replaced in November or December 1975. Due to this uncertainty factor, the system must currently be relegated to a lesser desirable position until more information is known about GS plans and future load estimates.

IBM 370/ 155 Configuration

- Supports teleprocessing operations through (2) Memorex 1270 terminal controllers under HASP and TSO.
- Services 150 remote terminals including DATA 100, IBM 2741, IBM 2780, Hazeltine 2000.
- Tied by 9600 Baud leased lines to Menlo Park, California; Denver, Colorado, and Washington, D. C. (to the GS IBM 360/65). Capable of executing programs at the command of the GS IBM 360/65 at Washington, D. C.
- Main memory: 4 million bytes of core storage.
- Auxiliary memory: Disc ITEL 7330 (IBM 3330 equivalent) - 32 spindles (3. 2 billion bytes, total), IBM 2314 - 8 drives (233. 6 million bytes, total). Drum (1) IBM 2303 (. 64 billion bytes).
- Magnetic tapes: (2) 7-track (556/800 bytes per inch) and (8) 9-track (800/ 1600 bytes per inch).
- Line printers: (1) IBM 1403 (1100 lines per minute), (1) IBM 3211 (2000 lines per minute).

- Card readers: (1) IBM 2501 (1000 cards per minute).
- Card read/punch: (1) IBM 2540 (Read: 1000 cards per minute-Punch: 300 cares per minute).
- Configuration change plans: System on lease to expire November - December, 1975. A second IBM 370/155 has been proposed for acquisition July-August, 1975 (see below). Current system replacement not defined, but probably will be compatible with IBM 370/ 155 architecture.
- Comments: Current 24-hour/day operation.
  Heavily committed.

Proposed IBM 370/ 155 Configuration -- Second Machine

- Will support teleprocessing operations through (1) Memorex 1270 terminal controller under HASP and TSO.
- To be connected, by switch, to the existing IBM 370/155 configuration. Will share peripherals and load.
- Main memory: 4 million bytes of core storage.
- Auxiliary memory: Disc ITEL 7330 (IBM 3330 equivalent)- 12 spindles (1. 2 billion bytes, total), IBM 2314 - 8 drives (233. 6 billion bytes, total). Drum (1) IBM 2305 (5. 4 million bytes).
- Magnetic tapes: (1) 7-track (556/800 bytes per inch), (6) 9-track (800/ 1600 bytes per inch).
- Line printers: (1) IBM 3211 (2500 lines per minute).
- Card readers: None
- Card punch: None
- Comments: Proposed for installation July-August, 1975.

11.6 Department of Agriculture IBM 360/65

The DOA IBM 360/65 system has the storage and teleprocessing attributes necessary to support the OCS Data Management System. However, it is dedicated to the DOA mission to the point that other agency applications are assigned lesser priority and it is considered at or near its maximum load capacity. For these reasons, it is not recommended.

IBM 360/ 65 Configuration

- Supports teleprocessing operations through (1) Memorex 1270 terminal controller under HASP and TSO.

- Services 10-15 DOI agencies in the New Orleans area. Remotes include (4) IBM 360/20, (4) IBM 1130, (7) IBM 2741, (7) IBM 2780, (8) IBM 3270.
- Main memory: 3.25 million bytes of core storage.
- Auxiliary memory: Disc IBM 3330 equivalent - 52 spindles (5. 2 billion bytes, total), IBM 2314 - 6 drives (175. 2 million bytes, total). Drum (1) IBM 2301 (4 million bytes).
- Magnetic tapes: (10) 7-track (556/800 bytes per inch) and (14) 9-track (800/1600 bytes per inch).
- Line printers: (3) IBM 1403 (1100 lines per minute).
- Card read/punch: (2) IBM 2540 (Read: 1000 cards per minute--Punch: 300 cards per minute).
- Configuration change plans: System to be replaced June, 1976 by a machine of undefined manufacturer.
- Comments:
  BLM uses system for lease connected computations.
  System is one of four DOA national data processing centers.
  Current 24-hour/day operation.
  Considered at or near maximum load capacity.

11.7 INFONET Univac 1108

Although of lesser desirability than government owned and operated systems, the Computer Sciences Corporation INFONET system does have the teleprocessing and storage attributes required by OCS Data Management System. With the potential availability of the two Geological Survey machines in Washington, D.C. (discussed in Sections 11.4 and 11.5, above) and the proposed BLM facility in Denver (outlined in Section 11. 1), the application of the OCS Data Management System to INFONET is rejected.

INFONET Univac 1108 Configuration

- Centers located in Oakbrook, Illinois and El Segundo, California.
- Supports teleprocessing operations.
- Can service DATA 100/90, DATA 100/78, IBM 2741, IBM 2780 terminals.
- Main memory: 64 thousand words.

- Auxiliary memory: An extendable 2000 pages per user identification (512 36-bit words/page).
- Magnetic tapes: 7-track (800 bytes per inch), 9-track (800 bytes per inch) at INFONET centers.
- Line printers: user supplied
- Card readers: user supplied
- Card punch: user supplied
- Comments: Capabilities described in GSA Operation Support Division publication DPM 2. 14, Users Guide for Teleprocessing Services.

12.0 OCEANOGRAPHIC AND WATER QUALITY DATA SYSTEM ASSESSMENT

The capabilitiess of four oceanographic and water quality data s ys - terns were evaluated to determine their applicability in meeting B LM's com- plete system requirements. The four systems selected for evaluation are GURC's oceanographic data system, NODC's oceanographic data system, EPA's water quality data system and Westinghouse's oceanographic data system. Each of these systems consist of two components: a data base management sys tern and a functional and utility program library. Each system also provides, to some degree, data cone ction and input forms, facilities for preprocessing data before entry into the data base, and various data services for users of the system.

In order to meet BLM's total OCS data base management and functional processing requirements, the system must include the following capabilities:

- Oceanographic data application orientation.
- Capacity to handle a large variety of OCS data.
- A complete and versatile data base management system.
- A comprehensive library of oceanographic analysis programs.
- General set of utility packages including graphics and and statistics.
- A remote batch and interactive capability oriented toward the scientific user.
- Easily adaptable to new requirements.
- Ability to produce flexible outputs.

The systems evaluated are described in detail in Appendix D. A summary of system overall capabilities is provided in the following:

12.1 EDMPAS -- Gulf Universities Research Consortium Data System

The GURC Environmental Dependent Management Process Analyses and Simulation (EDMPAS) system has been primarily oriented to managing oceanographic data for environmental studies of the Gulf of Mexico. The scope of GURC programs has broadened beyond marine sciences, however. GURC has handled a variety of data including biological, physical, geological, chemical, economic and legal data. They have collection forms for specific types of data, but do not seem to be standard in format.

The GURC data base management system is oriented toward problem specific data bases for individual scientists as opposed to a centralized data base which is accessed by all participants. The GURC system only utilizes sequential file access techniques and does not support inverted files. Thus, use of the GURC system for large data bases may be time consuming. GURC does have a respectable utility library which includes a general graphics capability that provides a flexible means of outputs including cartesian plots, a variety of maps and pages of text. A basic statistics package is described in their documentation, but it lacks the sophistication needed for the OCS data. However, their analysis capability seems to be more than adequate, although not complete. The GURC system is modularly designed so that other analysis programs could be appended to their library without undo difficulty. Finally, and perhaps overriding other considerations, there is some question regarding the system's availability, since the GURC software may be proprietary.

12.2 NODC -- National Oceanographic Data Center System

NODC is the established national oceanographic data center. Their experience in handling certain types of oceanographic data is definitely an asset. However, their ability to handle the variety of data produced by the OCS study is questionable. It is felt that the system would have to be extended to perform the complete processing required. NODC has a standard data documentation form which is excellent for defining the data collected and the necessary supporting information, but is not complete for all OCS data. The data base management system is retrieval oriented from fixed record format files. Functional and utility programs tend to apply to specific applications as opposed to more general and flexible applications. Most of the analysis programs are in the physical oceanography category. The system seems to be fairly rigid in structure and not easily adaptable to new requirements in a limited amount of time. The outputs produced by the system are in tabular and graphic form with standard formats that leave little room for flexibility.

An NODC in-house interactive capability does exist and a full remote capability is to be added in the near future. The center provides a variety of data services for the user including reference information and inventories.

12.3 STORET -- Environmental Protection Agency System

EPA' s Storage and Retrieval (STORET) system handles water quality data and water pollution cause data. STORET handles only two types of data files and information from both files cannot be acces sed at one time. A user can use STORET for another application, but he must identify his data parameters with EPA approved codes. STORET does not support inverted files, and the functional and utility programs are oriented to water quality data and seem to lack the sophistication needed in the OCS study. All the programs are written in PL/1 and, therefore, tied to IBM 360/370 computers. A remote interactive capability does exist under STORET, but requires the potential user to have specialized training. EPA does have standard data forms for water quality data,. but STORET documentation is felt to be inadequate.

12.4 UBSDB -- Westinghouse Oceanographic Research Laboratory System

Westinghouse's Upper Bay Survey Data Base (UBSDB) system handles and processes oceanographic data. This system handles a variety of data including hydrography, meteorology, marine geology, biochemistry, microbiology, and marine biology. The primary involvement of the system has been a study to determine the levels, pathways and effects of contaminants in the Chesapeake Bay. The data base management system employed within UBSDB is SYSTEM 2000 which Westinghouse utilizes via the Control Data CYBERNET time - sharing service, a commercial system which provides services for thousands of customers throughout the country through remote terminals. No information is known about UBSDB's functional and utility capabilities or the outputs it produces. CYBERNET facilities are extensively used.

12.5 Data System Assessment

Each of the systems described above would have to be extended to handle the complete processing required of the OCS data. The degree of extension would vary from one system to the other. All of the systems would have to define the data structures and organizations to encompass the entire spectrum of OCS data. They would also have to add to their present functional and utility program libraries to fulfill the OCS analysis requirements. All are lacking in some system requirements as is briefly indicated in the above system descriptions.

STORET would probably require the greatest degree of extension because of its present water quality data orientation. There is not enough information on Westinghouses total system to provide a definite conclusion regarding its usefulness. GURC and NODC come the closest to satisfying OCS requirements, however, they too fall short. Although it is felt that these systems do not fulfill BLM's total environmental data processing requirements, and should be rejected on that accord, they should be considered candidates for an interim processing capability to be used until a complete OCS Data Management System is developed.

13.0 DATA BASE MANAGEMENT SYSTEM ASSESSMENT

Numerous software data processing packages were identified through literature collected and researched during this task. Most of these were excluded from further consideration after a preliminary evaluation on the trite ria that they be currently available and fulfill the data handling requirements of the BLM OCS program.

The remaining systems were evaluated according to criteria selected from requirements defined in Section 7.0. In addition, each system was evaluated using certain subjective or qualitative considerations such as skill level requirements, direct access storage overhead, performance, etc. The one system that satisfied most of the established criteria was SYSTEM 2000.

The selection of SYSTEM 2000 was substantiated by an evaluation of existing commercial data management systems entitled "Ground Water Data Management Systems Study" prepared for the Water Resources Division of Geological Survey by the Program Analysis Department of the Naval Weapons Engineering Support Activity. SYSTEM 2000 was selected from a group of 76 data handling systems including ADABAS, IDMS, IMS -2, Metal-base and Total.

The following sections present details of the assessment.

13.1 Approach

The firs t function of this task was to identify the requirements with which any candidate system must comply. In addition to requirements outlined in Section 7, consideration was given to an indepth sizing of the MAFLA benchmark study, presented in Appendix B, as representative of future baseline monitoring programs and illustrative of data types, forms, relationships and potential volume. This was accomplished to determine the required data base structure and organization.

After the OCS data base management system requirements were solidified, they were compared to the standard features of the six types of data handling systems defined in Table 13-1. In this way, certain types were excluded as a category, while systems falling under the remaining categories were retained for further consideration.

Next, the attributes of the systems under investigation EDMPAS (GURC), GIM (TRW), GIPSY (U of O), IMS (IBM) NODC (NOAA), STORET (EPA), SYSTEM 2000 (MRI), and UBSDB (Westinghouse) were summarized according to a concise list of features generally common to data base management systems. These features are outlined in Table 13-2 and the system summary is provided in Table 13-3.

The final step was to establish a set of evaluation criteria on which to judge the systems being considered. These criteria are presented in Table 13-4.

13.2 System Type Selection

The requirements identified in Section 7 indicate a need for a sophisticated compute r software package for managing data. Of the six categories of software systems defined in Table 13-1, three -- Report Generators, Special Purpose Software and Teleprocessing Monitors -- were deemed inappropriate, since they were too function oriented and not broad enough in scope.

TABLE 13-1

DATA SYSTEM CLASSIFICATIONS

- File Management System (FMS) --Systems which perform the full gamut of data processing: input of data, file maintenance, queries and formatted reports. A major characteristic is that they are file or function oriented.
- Data Base Managers (DBM)--Systems which are oriented to the collection, maintenance and manipulation of data enmass e. A data base manager is differentiated from a file manager in that it cros ses file boundaries, physical data structures are transparent to the user who deals only with the logical interrelationships of data, means for rapid location of data are provided (non-sequential searches), and logical retrieval structures are automatically maintained by the system , hopefully transparent to the user.
- Data Base Management System (DBMS) - -An expansion of the data base manager in that the system not only performs all of the functions of a DBM, but also provides a report generation capability, a data base loading facility, a teleproces sing monitor or interface, and /or a query language.
- Report Generation (RG) --Packages which provide primarily a retrieval and output generation capability.
- Special Purpose Software (SPC) --This category covers software packages designed to perform special or specific tasks, such as text processing, improved direct or indexed sequential access methods, shorthand program genrators or file-to-file utilities.
- Teleprocessing Monitors (TPM)--These systems act as communications monitors and task schedulers for teleprocessing requirements.

TABLE 13-2

DATA BASE MANAGEMENT FEATURES

	FEATURE	QUALITY
1.	DATA BASE ORGANIZATION	Types of data structures handledby the systems.
2.	DATA STRUCTURE LIMITS	Variable data records or fixed data records.
3.	DATA BASE LANGUAGE FACILITY	Method of defining data elements and logical data interrelationships.
4.	UPDATE FEATURES	Which mode the updates are processed (batch, remote batch, interactive) and what security levels can be de-fine d.
5.	RETRIEVAL FEATURES	Access modes and methods.
6.	REPORT GENERATION/SORT FUNCTION	Whether the system has these capa-bilitiess.
7.	SYSTEM SOURCE LANGUAGE	The prog ramming language in which this system was coded.
8.	QUERY LANGUAGE	Characteristics of the query language.
9.	APPLICATION/HOST LANGUAGES	Languages acceptable by the system as host processors or own-code additions.
10.	TELEPROCESSING	Whether teleprocessing is provided by system. If not, the interfacable sys - terns which provide this capability.

TABLE 13-2 (Continued)

	FEATURE	QUALITY
11.	CPU AND OPERA TING SYSTEM REQUIREMENTS	The computers /models and operating systems which the management system will run on with minimum core require - ments.
12.	ERROR RECOVERY	Whether checkpoint/restart is provided.
13.	SYSTEM USAGE	Current applications of the system.
14.	COST	Purchase and/or lease price.
15.	INTERFACE TO FUNCTIONAL PROGRAMS	Whether the system has an interface and add-on facility for functional programs.
16.	OTHER PER TINENT FEATURES	Unique system capabilities or characteristics, pertinent comments.

TABLE 13-3. DATA SYSTEM SURVEY (Sheet 1 of 4)

FEATURE LIST \ SYSTEM NAME	EDMPAS	GIM	GIPSY	IMS	NODC	STORET	SYSTEM 2000	UBSDB
VENDOR/ ORGANIZATION	GURC GALVESTON, TEX	TRW LOS ANGELES	UNIVERSITY OF OKLAHOMA	IBM WASHINGTON, D. C.	NOAA WASHINGTON, D. C,	EPA WASHINGTON, D. C.	MRI AUSTIN, TEXAS	WESTINGHOUSE SUITLAND, M
SYSTEM TYPE	ENVIRONMENTAL PROBLEM ORIENTED DBMS	GENERAL DBM	GENERAL FMS	GENERAL DBMS	OCEONOGRAPHIC DBM	WATER QUALITY STORAGE AND RETRIEVAL SYSTEM DBM	MODULAR, SELF CONTAINED RETRIEVAL ORIENTED DBMS	OCEANOGRAPHIC DBMS (uses system 2000)
1. DATA BASE ORGANIZATION	INDEXED SEQUENTIAL	INDEXED SEQUENTIAL	INDEXED SEQUENTIAL OR INDEXED DIRECT	HIERARCHICAL SEQUENTIAL AND HIERARCHICAL DIRECT (tree structure)	PARTIALLY INVERTED STRUCTURE	INDEXED DIRECT	PARTIALLY INVERTED HIERARCHICAL STRUCTURE	—
2. DATA STRUCTURE LIMITS	FIXED PHYSICAL RECORDS, VARIABLE LOGICAL RECORDS	FIXED PHYSICAL RECORDS, VARIABLE LOGICAL RECORDS	VARIABLE PHYSICAL RECORDS, VARIABLE LOGICAL RECORDS	VARIABLE RECORDS WITH VSAM	VARIABLE PHYSICAL RECORDS	VARIABLE RECORDS	FIXED RECORDS	—
3. DATA BASE LANGUAGE FACILITY	ENVIR COMMAND LANGUAGE	GIMCOM COMMANDS	QUESTRAN COMMAND LANGUAGE	DATA LANGUAGE/1	TSO COMMANDS	DISTRIBUTE COMMANDS	DATA DEFINITION LANGUAGE, IMMEDIATE INQUIRY LANGUAGE, PROCEDURAL DATA MANAGEMENT LANGUAGE	—

TABLE 13-3. DATA SYSTEM SURVEY (Sheet 2 of 4)

SYSTEM NAME / :ATURE LIST	EDMPAS	GIM	GIPSY	IMS	NODC	STORET	SYSTEM 2000	UBSDB
UPDATE FEATURES	UPDATE IN ALL MODES. ADD RECORDS OR DESCRIPTORS DELETE RECORDS. CORRECT ERRORS. NO SECURITY INFORMATION	UPDATE IS ENCOURAGED TO BE PERFORMED IN THE BATCH MODE. OTHER-WISE ALL USERS ARE LOCKED OUT OF ACCESSING THE DATA BASE PASSWORD LOCKS AT THE FILE, RECORD AND DATA ELEMENT LEVEL	UPDATE ONLY IN THE BATCH MODE. NO SECURITY INFORMATION	UPDATE IN ALL MODES. SECURITY TO FOR FILE AND RECORD LEVEL	UPDATE ONLY IN BATCH "MODE. PASSWORD PROTECTED	UPDATE IN ALL MODES. PASSWORD PROTECTED	UPDATE IN ALL MODES. SECURITY FOR FILE, RECORD AND FIELD LEVELS	
RETRIEVAL FEATURES RETRIEVAL IN REMOTE BATCH AND INTERACTIVE MODES MORE THAN ONE ACCESS TECHNIQUE	RETRIEVAL IN ANY MODE. SEQUENTIAL ACCESS. (SAM)	RETRIEVAL" IN ANY MODE. SEQUENTIALOR SELECTED ACCESS. (SAM)	RETRIEVAL IN ANY MODE. IBM SEQUENTIAL ACCESS AND DIRECT SEQUENTIAL ACCESS (Q SAM, GIP SAM)	RETRIEVAL IN ANY MODE. MULTIPLE ACCESS METHOD S (VSAM, ISAM, OSAM, BSAM, SAM, V TAM)	RETRIEVAL IN ANY MODE. SEQUENTIAL ACCESS (SAM)	RETRIEVAL IN ANY MODE. SEQUENTIAL ACCESS (SAM)	RETRIEVAL IN ANY MODE. MULTIPLE ACCESS METHOD S (BDAM, BSAM, BPAM)	
REPORT GENERATION SORT CAPABILITY	YES, HAS LIST CAPABILITY AND SORT CAPABILITY	YES, HAS REPORT GENERATOR. HAS SORT CAPABILITY	YES, HAS PRINT AND LIST CAPABILITY HAS SORT CAPABILITY	YES, GIS/VS AND GIS-2 HAS SORT CAPABILITY	YES, HAS SORT CAPABILITY	YES, SEVERAL WATER QUALITY LIST AND INVENTORY PROGRAMS	YES, SELF CONTAINED REPORT WRITER FEATURE, HAS SORT CAPABILITY	
SYSTEM SOURCE LANGUAGE HIGHER LEVEL LANG.	FORTRAN V	LOW LEVEL MACRO ASSEMBLY	360 ASSEMBLY	360 ASSEMBLY	.360 ASSEMBLY	PL/I	FORTRAN, ASSEMBLY	

TABLE 13-3. DATA SYSTEM SURVEY (Sheet 3 of 4)

FEATURE LIST \ SYSTEM NAME	EDMPAS	GIM	GIPSY	IMS	NODC	STORET	SYSTEM 2000	UBSDB
8. QUERY LANGUAGE ENGLISH LANGUAGE, FREE FORM BOOLEAN LOG I C	ENGLISH LANGUAGE, FREE FORM. BOOLEAN LOG I C	ENGLISH LANGUAGE BOOLEAN LOGIC	ENGLISH LANGUAGE, FREE FORM BOOLEAN LOG I C	STRING	TSO LANGUAGE	TSO LANGUAGE t, REQUIRES ADVANCED SPECIALIZED TRAINING	ENGLISH-LIKE, FREE-FORM	→
9. APPLICATION/ HOST LANGUAGES FORTRAN	FORTRAN IV, V, ASSEMBLY	FORTRAN IV, V COBOL DML ASSEMBLY (only with CSTS)	COBOL FORTRAN PL/I ASSEMBLY	COBOL PL/I ASSEMBLY	FORTRAN ASSEMBLY	PL/I FORTRAN ASSEMBLY	COBOL PL/I FORTRAN ASSEMBLY	→
). TELEPROCESSING	YES	NO-CSTS (computer sciences, teleprocessing system)	YES, ALSO TSO	YES, ALSO WITH CICS	NO- TSO	YES, MULTI NO -TSO TEAM, CICS,	YES, MULTI-THREADTP 2000 TEAM, CICS	→
1. CPU + OPERATING SYSTEM REQUIREMENTS MULTI PLE SYSTEM VERSIONS	UNIVAC 1100 SERIES IBM 360/370 SERIES CDC 6000 SERIES ENVIR - 20K ON UNIVAC 27K ON IBM	UNIVAC 1108, CSTS OPERATING SYSTEM IBM 360/40, IBM 370/135 0s 50K BYTES ON OS	IBM 3601 370/155, 0s 63K BYTES	IBM 360, 370 MODELS 40, 145 AND UP OS/ MFT, VSI, VS2 IMS-2-DB: 128K (MFT) 256K (MVT) DB/DC: 512K (VSI) 761K (V52) FMS/VS-DB: 90K PARTITION DB/DC: 350K PARTITION	IBM 360/65 0s	IBM 360/65 0s 2D0K BYTES	IBM 360, 370 MODELS 40, 145 AND UP 0s, OS/VS UNIVAC 1100 EXEC 8 CDC 6000, CYBER 70 SCOPE, KRONOS IBM-256K BYTES UNIVAC-32K WORDS CDC-18K WORDS	→
2. ERROR RECOVERY	NS	YES	NS	YES	NS	NS	YES	→

TABLE 13-3. DATA SYSTEM SURVEY (Sheet 4 of 4)

FEATURE LIST \ SYSTEM NAME	EDMPAS	GIM	GIPSY	IMS	NODC	STORET	SYSTEM 2000	UBSDB
3. SYSTEM USAGE	SCIENTIFIC RESEARCH PROBLEMS, OCEANOGRAPHIC DATA PROCESSING	RUNS UNDER COMPUTER SCIENCE CORPORATIONS INFONET	MINERAL DATA PROCESSING AT GEOLOGICAL SURVEY, BIBLIOGRAPHIC DATA ATNODC	MAINLY BUSINESS APPLICATIONS	OCEANOGRAPHIC DATA PROCESSING	WATER QUALITY DATA PROCESSING	USED BY WESTINGHOUSE FOR OCEANO-GRAPHIC DATA PROCESSING	
4 COST	NS	$2000/mo	AVAILABLE THRU GEOLOGICAL SURVEY NODE	MONTHLY LICENSE ONLY $616-$2825 DEPENDING ON OPTIONS	GOVERNMENT OWNED	GOVERNMENT OWNED	$30K PURCHASE (basic system)	
5. INTERFACE TO FUNCTIONAL PROGRAMS	YES, BINARY SUBSET FILE OTHER COMPUTATIONS INTERFACES	YES, CSTS EXTERNAL FILE	YES, "COPY" FILE	YES	YES	YES	YES, PROCE-DURAL LANGUAGE INTERFACE TO PERMIT USER APPLICATION PROGRAMS TO ACCESS DATA BASE	
6. OTHER PERTINENT FEATURES	COMPRESSED BINARY DATA FILES DIRECT EXCHANGE OF DATA FILES FROM COMPUTER TO COMPUTER DICTIONARIES BUILT FROM INPUT DATA	ANY SPEED TERMINAL IBM 2741 UNIVAC DCT 500 DATA POINT 2200	MAX RECORD SIZE32K BYTES IBM 2741 OR CONVENTIONAL TELETYPE		COMPUTER CAPACITY: 2 1/2 MILLION BYTES IN-HOUSE TERMINALS ONLY	LOW SPEED TERMINAL IBM 2741 DATEL 30 TTY MEDIUM SPEED TERMINALS IBM 2780, 1130 DATA 100 COPE 30 NATIONAL NETWORK	LOGGING OF UPDATING TRANSACTIONS IS MAINTAINED	

TABLE 13-4. EVALUATION CRITERIA (Sheet 1 of 2)

- **OPERATIONAL ON TARGET COMPUTER CONFIGURATION**

  THE SYSTEM MUST BE OPERATIONAL ON THE DO I IBM 360/65 COMPUTER

- **TRANSFERABILITY OF SYSTEM TO OTHER COMPUTER CONFIGURATIONS**

  THE SYSTEM MUST EITHER BE WRITTEN IN A MACHINE INDEPENDENT LANGUAGE OR EXIST IN MULTIPLE VERSIONS ADDRESSED TO SEVERAL MACHINES

- **REMOTE AND INTERACTIVE CAPABILITY**

  THE SYSTEM MUST BE DESIGNED TO FACILITATE INTERACTIVE OPERATION TO SYSTEM REMOTES FOR STORAGE, RETRIEVAL AND UPDATE FUNCTIONS

- **FILE STRUCTURE VERSATILITY**

  THE ABILITY TO DEFINE DIFFERENT STRUCTURED DATA FILES

- **MULTIPLE KEY SELECTIONS**

  THE SYSTEM MUST PERMIT THE USER TO DESIGNATE ANY DATA ELEMENT OR GROUP OF ELEMENTS AS DATA SELECTION KEYS

- **MULTIPLE FILE HANDLING CAPABILITY**

  THE SYSTEM MUST BE ABLE TO MANIPULATE FILES OF VARIOUS STRUCTURE AND MERGE FILES OF DIFFERING LENGTHS AND COMMON KEYS

- **INVERTED FILE CAPABILITY**

  THE SYSTEM SHOULD PROVIDE FOR THE USE AND MAINTENANCE OF INVERTED DATA FILES

- **HIERARCHICAL DATA STRUCTURE**

  THE SYSTEM MUST UTILIZE AND MAINTAIN HIERARCHICAL DATA STRUCTURES

- **VARIABLE LENGTH RECORDS AND FIELDS**

  THE SYSTEM MUST HAVE THE CAPABILITY OF HANDLING LOGICAL RECORDS AND FIELDS OF VARIABLE LENGTH

TABLE 13-4. EVALUATION CRITERIA (Sheet 2 of 2)

- ENGLISH LANGUAGE, FREE-FORM QUERY

  THE SYSTEM QUERY LANGUAGE MUST BE ENGLISH-LIKE, AND FREE-FORM TO ALLOW USAGE BY THE NON-PROGRAMMER

- THE BOOLEAN LOGIC CAPABILITY

  THE SYSTEM MUST AFFORD THE USER RECORD SELECTION WITH BOOLEAN LOGIC (and, or, not)

- RAPID DATA SELECTION AND RETRIEVAL

  THE SYSTEM MUST HAVE A RAPID DATA ACCESS METHOD

- PROCESSOR INTERFACE

  THE SYSTEM MUST PROVIDE THE CAPABILITY FOR USER DEVELOPED PROGRAMS TO ACCESS THE DATA BASE THROUGH A WELL DESIGNED INTERFACE

- FORTRAN, COBOL LANGUAGE INTERFACE

  THE SYSTEM MUST PROVIDE AN INTERFACE TO FORTRAN AND COBOL LANGUAGE

- REPORT GENERATOR CAPABILITY

  A GENERAL REPORT GENERATING CAPABILITY MUST BE PART OF THE SYSTEM

- SORT CAPABILITY

  THE SYSTEM MUST BE CAPABLE OF PROVIDING RETRIEVED DATA IN KEY SORT ORDER

- COMPLETE AND CLEAR SYSTEM DOCUMENTATION

  COMPLETE AND CLEAR DOCUMENTATION OF THE SYSTEM INCLUDING A USER'S GUIDE, COMPUTATIONAL SYSTEM DESCRIPTION AND EXECUTIVE SYSTEM DESCRIPTION IS REQUIRED

The three remaining categorizations were actually divided into two conceptual approaches : file management and data base management. It was intuitively felt that B LM' s application could readily be accomplished under the data base approach. However, this intuitive rationale could not be extended to file management systems.

There was little doubt that a file management system could be found which would be able to maintain the OCS data and provide all the data reporting capabilities required. However, the need for responsiveness to changing retrieval requirements, data set level data base definitions, hierarchical and inverted structure, multiple file handling and program/data independence rules out their use. Neverthelesss, one file management system (GIPSY) was evaluated in order to compare its attributes with those of a data base management system. GIPSY is used for environmental data by both NODC and the Geological Survey.

The two remaining systems, data base managers and data base management systems have similar characteristics. A data base system consists of three separate but related areas: the data base, the data maria - ger, and the data base/user interface modules. (This terminology is defined in a glossary within Appendix F.) The data base management system on the other hand, contains system software in addition to that provided with the data base manage r. If the system evaluated is categorized a data base manage r, then cons ide ration will be given to its ability to interface with other available packages to substitute for those application modules needed by ELM, but not provided by the system.

In summary, during initial screening of all the packages or sys - terns identified during this study, those not categorized as either a data base manager or a data base management system were pre-emptively rejected.

13.3 Assessment Conclusions

Based on the comparison of each system's capabilities with BLM's requirements, six of the systems should be eliminated from further consideration. This conclusion was based on the number of mandatory requirements each system failed to meet. The following systems were eliminated for the reasons stated:

<u>EDMPAS</u> EDMPAS is oriented toward small, problem oriented data bases maintained for individual scientists as opposed to a centralized data base that can be accessed by all system users. The EDMPAS data base structure is sequential and data can only be accessed with a sequential search. EDMPAS does not support inverted files, nor does it provide a capability for defining hierarchical data structures -- a requirement for extensive manipulation of biological data,

<u>GIM</u> GIM does not provide an interface capability with a host language. However, this interface requirement is of no consequence under the Computer Science Corporation's INFONET system -- a possibility that has been rejected. GIM's data base manipulation capabilities are also poor, since it is restricted to index sequential searches. GIM does not provide a capability for defining hierarchical data structures.

<u>GIPSY</u> GIPSY is a file management system which is not oriented to scientific applications, and does not possess the file retrieval capabilities required to manipulate OCS data. It is mainly used to process text materials and to retrieve bibliographic information from small files. Retrieval of data using GIPSY is considered expensive according to NODC. GIPSY

GIPSY (Cont.) runs only on the IBM 360/370 series computers and is written in 360 assembly language. Its transferability, therefore, is extremely limited.

IMS IMS does not support FORTRAN as a host language. Since most of the functional programs in the scientific community are written in FORTRAN, this feature is necessary. IMS is oriented to business data management problems and its use is considered too complex for the OCS application. It is heavily based on the existing physical data management facilities of the IBM 360/370 line and subsequently demands an inordinate degree of effort and skill by the user to develop an efficient system for the simplest of applications.

NODC NODC's data management system only runs on the IBM line of computers. Interactive retrieval is available only for certain types of data files. Updating is done in the batch mode of operation. NODC is also lacking in file structure versatility and multiple file handling.

STORET STORET only handles two types of data files. Information from both files cannot be accessed at one time. Therefore, merging of file information is awkward. STORET has no inverted file capability, and data must be accessed by specific indices. In order to use STORET, a user requires specialized training. It is possible to use STORET for an application other than water quality; however, the user's data parameters must be confined to EPA's approved codes. The system could be converted to another

STORET (Cont.)

IBM computer, but it would take non- STORET system personnel one to two months to accomplish the task, because of inadequate documentation. Since STORET is written in PL/I, it is essentially confined to the IBM series of computers.

The remaining system, SYSTEM 2000, seems fully capable of satisfying BLM's OCS environmental data handling requirements, and is recommended for use. The following comments summarize the reasons for selecting SYSTEM 2000 to satisfy BLM's data base management system requirements.

SYSTEM 2000

SYSTEM 2000 is transferable to other computer configurations. It exists in versions which operate on CDC Cyber 70, IBM 360/370, and Univac 1100 series computers. SYSTEM 2000 not only performs all the data base management functions required, but also provides an English-like, free-form query language, several versions of a teleprocessing monitor, and a self-contained report generator. It is highly suited for use by the non-programmer, because of simple query language and clear, concise diagnostic messages.

SYSTEM 2000 provides an inverted file capability for rapid entry into any of 64 levels of the hierarchical data structure. Upward searching of the hierarchical tree structure is permitted. Several tree structures may be defined for each file. The hierarchical data relationship and the specification of multiple key data elements, is also user defined. The ability for emerging and manipulating multiple files with different data structures is provided, and values for data elements can vary in length.

The system requires minimal maintenance, and easily accommodates new applications without major programming changes. A FORTRAN, COBOL, PL/ 1 or assembly language interface is provided to accommodate data base requests from user-prepared programs.

SYSTEM 2000 is widely used for environmental data systems by government and industry. These organizations include Westinghouse e, the Environmental Protection Agency, the Geological Survey and the Corps of Engineers.

The results of the data base management system evaluation are summarized in Table 13-5, presented below. The Westinghouse UBSDB system is not included since its data base management capabilities stem from SYSTEM 2000 which is represented within the table.

TABLE 13-5. DATA HANDLING SYSTEM EVALUATION SUMMARY

REQUIREMENT \ SYSTEM	EDMPAS	GIM	GIPSY	IMS	NODC	STORET	SYSTEM 2000
OPERATIONAL ON TARGET COMPUTER CONFIGURATION (IBM 360/65)	√	√	√	√	√	√	√
TRANSFERABILITY OF SYSTEM TO OTHER COMPUTER CONFIGURATIONS	√	√					√
REMOTE AND INTERACTIVE CAPABILITY	√	√		√		√	√
FILE STRUCTURE VERSATILITY			√	√			√
MULTIPLE FILE HANDLING CAPABILITY	√	√	√	√	√		√
MULTIPLE KEY SELECTIONS	√			√			√
INVERTED FILE CAPABILITY				√	√	√	√
HIERARCHICAL DATA STRUCTURE				√			√
VARIABLE LENGTH RECORDS AND FIELDS	√	√	√	√			
ENGLISH LIKE, FREE-FORM QUERY LANGUAGE	√		√	√			√
BOOLEAN LOGIC CAPABILITY	√	√	√	√	√		√
RAPID DATA SELECTION AND RETRIEVAL				√		√	√
PROCESSOR INTERFACE	√	√	√	√	√	√	√
FORTRAN, COBOL LANGUAGE INTERFACE		√	√				√
REPORT GENERATOR CAPABILITY	√	√	√	√	√	√	√
SORT CAPABILITY	√	√	√	√	√	√	√
COMPLETE AND CLEAR DOCUMENTATION	√	√	√	√			√

14.0 FUNCTIONAL AND UTILITY SOFTWARE ASSESSMENT

A survey was conducted to identify computer programs to fulfill BLM's functional and utility processor requirements. The objective of the survey was to select available programs written in FORTRAN IV/V or COBOL compiler languages. The programs are restricted to these languages because of the computer independence requirement which was established for Data Management System software. Other higher level languages are not supported on as many computers. For example, PL/ 1 is supported only by IBM. The ALGOL language is only supported on a very narrow range of computers. The recommended data base management system, SYSTEM 2000, has application language interface support for both FORTRAN and COBOL.

The programs used by the oceanographic data management systems of GURC and NODC were investigated. EPA's programs are mainly written in PL/ 1 and were therefore rejected. There was no information available on Westinghouse's utility and functional software. Programs used by the Geological Survey were also investigated including their comprehensive statistical package, STATPAC. An NODC publication entitled "Computer Programs in Oceanography" was used as one guide for Program selection. This document contains computer program abstracts and included the language of the program, the computer for which it was written and the originating organization. This document was published in 1970. A new version is expected to be published this year.

The utility programs include a graphics package, a statistics package and other mathematical programs such as curve fitting routines. The functional or analysis programs can be classified as biological oceanography, chemical oceanography, geoscience, and physical oceanography programs. The latter programs were not evaluated in detail. They were identified as potential candidates for BLM' s requirements because of their applicability to oceanographic analysis and their compatibility with the Data Management System. As far as selecting programs to satisfy specific applications for special studies, these specifications must be provided by the user.

Table 14-1 lists various agencies and institutions which have developed computer application programs in oceanography.

Table 14-2 lists programs written in FORTRAN IV or V that were selected as available candidates for BLM's application program library. This list was taken from NODC's computer program inventory and includes NODC programs. The table also indicates the computer on which the program was originated and the organization which developed it. There were no programs written in the COBOL language.

Table 14-3 lists FORTRAN IV/V program modules contained in GURC's application library.

Table 14-4 lists potentially applicable FORTRAN IV programs included within the Geological Survey's STATPAC.

Descriptions of the programs of GURC, NODC, and EPA can be found in Appendix D, entitled "Descriptions of Oceanographic and Water Quality Data Systems."

TABLE 14-1. AGENCIES AND INSTITUTIONS HAVING COMPUTER APPLICATION PROGRAMS IN OCEANOGRAPHY

Bureau of Commercial Fisheries	(BCF)
Canadian Oceanographic Data Centre	(CODC)
Coast and Geodetic Survey	(CGS)
Coast Guard Oceanographic Unit	(USCG)
Defense Research Establishment Pacific	(DREP)
Department of Energy, Mines and Resources, Canada	(DEMRC)
Fisheries Research Board of Canada	(FRBC)
Florida State University	(FSU)
Gulf Universities Research Consortium	(GURC)
Johns Hopkins University	(JHU)
Massachusetts Institute of Technology	(MIT)
National Institute of Oceanography	(NIO)
National Oceanographic Data Center	(NODC)
National Oceanographic Office	(NOG)
Naval Postgraduate School	(NPGO)
Naval Research Laboratory	(NRL)
Naval Ship Research and Development Center	(NSRDC)
Naval Undersea Research and Development Center	(NURDC)
Northwestern State University	(NU)
Pacific Oceanographic Group	(POG)
Rand Corporation	(Rand)
Scripps Institute of Oceanography	(Scripps)
Stanford University	(SU)
Texas A&M University	(TA&M)
University of California	(u of c)
University of Kansas	(U of K)
University of Rhode Island	(U of RI)
University of Texas	(U of T)
University of Toronto	(U of TOR)
University of Washington	(u of w)
University of Wisconsin-Milwaukee	(U of WM)
U. S. Department of Interior	(DOI)
U. S. Geological Survey	(USGS)
Woods Hold Oceanographic Institution	(WOHO)

TABLE 14-2. OCEANOGRAPHIC PROGRAMS INVENTORIED BY NODC (Sheet 1 of 5)

PROGRAM	COMPUTER	ORGANIZATION
Daily Seawater Observations	CDC 3100	CODC
Oceans Catalog I and II	CDC 3100	CODC
Statistics I, II, III	CDC 3100	DEMRC
Thermocheck - Temp. Correction	CDC 3100	CODC
CIRCSTST	CDC 3400	NU
BIOP (Biology Plot)	CDC 3600	Scripps
CHLOR	CDC 3600	Scripps
PROFL	CDC 3600	Scripps
S. T. D. Data Processing	CDC 3600	Scripps
Ray Tracing	CDC 3800	NRL
Sound Speed Profiles - Normal Modes	CDC 3800	NRL
Chlorophyll and Productivity	CDC 6400	U of W
Interpolation Program	CDC 6400	U of W
Multivariate Non-Linear Regression	CDC 6400	FSU
Simulation of Transgression in Time	CDC 6400	U of K
Harmonic Analysis of Tidal Data	CDC 6600	CGS
Tidal Current Prediction	CDC 6600	CGS
ECOPROD	CDC 6600	U of T
JOB (Species Diversity)	CDC 6600	U of T
Oxygen	CDC 6600	U of T
Power Spectrum of Geological Surface	GE 625	U of K
Trend Analysis Using Fourier Series	GE 625	U of K
Oxygen Computation	H-516	NOG
Phosphate Computation	H-516	USCG
Salinity Conversion	H-516	USCG
Thermometer Correction	H-516	USCG
Seakeeping	IBM 1130	USCG
Alert (Satellite Times)	IBM 1130	POG
ASORT (Sort O/P of Alert)	IBM 1130	POG
Anal. of Non-Linear Response Surfaces	IBM 1130	FRBC
Hydro (Compute from Hydro Data)	IBM 1130	POG
MULDA (Multiple Discriminant Anal.)	IBM 1130	FRBC
PLOG (Plot Hydro. Data)	IBM 1130	POG

TABLE 14-2. OCEANOGRAPHIC PROGRAMS INVENTORIED BY NODC (Sheet 2 of 5)

PROGRAM	COMPUTER	ORGANIZATION
RYLD (Fish Stock Yield)	IBM 1130	FRBC
Special Chemistry Calculations	IBM 1130	U of W
S. T. D. Calculations	IBM 1130	U of W
Transport Comp. From Atmos. Pressure	IBM 1130	POG
STPO1 (Compute From S. T. D. Data)	IBM 1130	FOG
STPO2 (Compute From S. T. D. Data)	IBM 1130	POG
Trend-Surface with Unrestricted I/P	IBM 1620	U of K
Brain con Data Reduction	IBM 1800	NIO
Cable Configuration	IBM 1800	NIO
Current Meter Analysis	IBM 1800	NIO
Current Meter Conversion	IBM 1800	NIO
HILOW	IBM 1800	NIO
HNAV (Loran/ Decca Coordinates Calc.)	IBM 1800	NIO
HNVI (Loran/ Decca File)	IBM 1800	NIO
SBWRO (Wave Recorder Analysis)	IBM 1800	NIO
SDANO (Inverse Geodetic)	IBM 1800	NIO
VAPW (Saturation Vapor Pres sure)	IBM 1800	NIO
CADS (Calc. Dependent Quantities)	IBM 1800	Scripps
GO (Pot. Temp. Sigma Theta, Oxy.)	IBM 1800	Scripps
Two Five (Data Reduction)	IBM 1800	Scripps
Transport Comp. From Atmos. Pressure	IBM 7040	POG
Power Spectrum of Geological Surface	IBM 7040	U of K
Trend Surfaces Degrees 1 to 6	IBM 7040	U of K
Simulation of Marine Sedimentation	IBM 7040	U of K
2-Dimensional Regression	IBM 7040	U of K
Cross-Association of Sequences	IBM 7040/44	U of K
Digital Power Spectrum Analysis	IBM 7090	NSR DC
Long. Strength of Ship Hull	IBM 7090	NSRDC
Partial and Ordinary Coherence	IBM 7090	NSR DC
Saved (Blast Test Data Reduction)	IBM 8090	NSR DC
Statistical and Peak-to- Peak Anal.	IBM 7090	NSR DC
Astronomical Tide Prediction	IBM 7090/94	CGS
Refraction of Waves	IBM 7090/94	SU
Simulation of Wind-Generated Waves	IBM 7090/94	SU
Sea Ice Studies	IBM 7090/94	Rand
Simulation of Marine Sedimentation	IBM 7090/94	U of K
Vector Trend Anal. Directional Data	IBM 7090/94	U of K

TABLE 14-2. OCEANOGRAPHIC PROGRAMS INVENTORIED BY NODC (Sheet 3 of 5)

PROGRAM	COMPUTER	ORGANIZATION
Wave Force Distribution	IBM 7090/94	MIT
Wave Forces and Moments	IBM 7090/94	MIT
Profil (Tsunami Profiles)	IBM 7094	U of C
Optimization of VTE Water Plants	IBM 7094	DOI
S. T. D. Correction	IBM 7094	TA&M
Time Term, Seismic Refraction Interp.	IBM 7094	U of TOR
Condu (Thermal Conductivity)	IBM 7094-11/ 7094 DCS	CGS
BKGEOL (Sediment Statistics)	IBM 7094-11/ 7040 DCS	U of W
Concentrations Per Square Meter	IBM 7094-11/ 7040 DCS	U of W
Phytoplankton Numbers, etc.	IBM 7094-11/ 7040 DCS	U of W
SDGVEL (Sounding Correction)	IBM 7094-11 7040 DCS	U of W
Sediment Granulometric Analysis	IBM 7094-11 7040 DCS	U of W
Wave Statistics	IBM 0S/ 360	FSU
Blacky (Time Series Analysis)	IBM 0S/ 360	NPGO
Current	IBM 0S/360	NPGO
DETRND, etc. (Spectra Subroutines)	IBM 360/40	MIT
LENG1 (Wave Length and Speed	IBM 360/40	MIT
Profile	IBM 360/40	MIT
Profl (Water Elev. Over Wave Period)	IBM 360/40	MIT
REFL1 (Reflected Wave)	IBM 360/40	MIT
UMAX1, etc. (Max. Flow Veloc.)	IBM 360/40	MIT
UOFT1, etc. (Flow Velocities)	IBM 360/40	MIT
Inventory Plot	IBM 360/40	NODC
Subroutine Map	IBM 360/40	NODC
RAYTR (Ray-Tracing)	IBM 360/44	DREP
AOU, ISAOU (Calc. of Oxygen, etc.)	IBM 360/65	BCF
GDNP, GRAD (Calc. of Oxygen, etc.)	IBM 360/65	BCF
GVPA, VPA (Calc. of Currents)	IBM 360/65	BCF
1S0S, OXOS, PHOS (Isentropic Plot)	IBM 360/65	BCF
Length-Weight Frequency	IBM 360/65	BCF

TABLE 14-2. OCEANOGRAPHIC PROGRAMS INVENTORIED BY NODC (Sheet 4 of 5)

PROGRAM	COMPUTER	ORGANIZATION
Long Wave Radiation	IBM 360/65	BCF
Oceanographic Report Preparation	IBM 360/65	BCF
Oceanographic Summary (Nos. 1, 2, 3)	IBM 360/65	BCF
Reversing Thermometer Correction	IBM 360/65	BCF
TSIP, THOX, THOT (Plot Time History)	IBM 360/65	BCF
Flow Meter Plots	IBM 360/65	BCF
General Mercator Plot	IBM 360/65	BCF
Horizontal Sections	IBM 360/65	BCF
In Site Oceanographic Data	IBM 360/65	BCF
Interpolation	IBM 360/65	BCF
Mercator Station Plot	IBM 360/65	BCF
Oxygen, Phosphate, Density Plots	IBM 360/65	BCF
Temperature-Salinity Curves	IBM 360/65	BCF
Oceans III	IBM 360/65	CODC
Thermocheck - Temp. Correction	IBM 360/65	CODC
Water Chemistry	IBM 360/65	USGS
Q-Mode Cluster Analysis	IBM 360/67	U of K
Optimum Track Ship R outing	Univac 1107	JHU
Newfit	Univac 1108	NUR DC
Pattern Function Calculations	Univac 1108	NUR DC
Ray Sort	Univac 1108	NUR DC
Sonar in Refractive Water	Univac 1108	NUR DC
Spectral Analysis of Time Series	Univac 1108	U of WM
Aziz (Thermometric Depth)	IBM 360/ 50	U of RI
Cards	IBM 360/ 50	U of RI
DELINT (Delta Calc and Interpolation)	IBM 360/50	U of RI
Depths	IBM 360/50	U of RI
Height	IBM 360/ 50	U of RI
Hydro	IBM 360/ 50	U of RI
Intest	IBM 360/50	U of RI
Lint (Linear Interpolation)	IBM 360/ 50	U of RI
RDTHRM (Read Thermometer Data)	IBM 360/50	U of RI
Sigma	IBM 360/ 50	U of RI
Sigmad	IBM 360/50	U of RI
Sigmat	IBM 360/50	U of RI
Temp	IBM 360/50	U of RI

TABLE 14-2. OCEANOGRAPHIC PROGRAMS INVENTORIED BY NODC (Sheet 5 of 5)

PROGRAM	COMPUTER	ORGANIZATION
TSPLOT	IBM 360/ 50	U of RI
UTEMP (Unprotected Thermometer)	IBM 360/ 50	U of RI
Percentage Saturation of Oxygen	IBM 360/65	USGS
Objective Termocline Analysis	CDC 6500	NPGO
Objective Thermocline Analysis	IBM 0S/360	NPGO
Astronomic Position	IBM 360/65	USGS
Profile Card-to-Tape for Geopac	IBM 360/65	USGS
TALWANI 2-D Gravity	IBM 360/65	USGS
Simulation of Deltaic Sedimentation	IBM 360/ 67	U of K
ATG (Adiabatic Temperature Gradient)	SDS Sigma 7	W OHO
Beta-Model with White Forcing	SDS Sigma 7	WOHO
Data	SDS Sigma 7	WOHO
DSTABF (Stability Frequency)	SDS Sigma 7	W OHO
HISTO (Histogram Plot)	SDS Sigma 7	W OHO
HYLOG (Hydro. Sta. Data Reduction)	SDS Sigma 7	W OHO
LISPLO (List and Plot	SDS Sigma 7	WOHO
NUSPEC (Spectrum Estimation	SDS Sigma 7	WOHO
OCCOMP (Oceanographic Compute)	SDS Sigma 7	WOHO
POTEMP (Potential Temperature)	SDS Sigma 7	WOHO
Press	SDS Sigma 7	WOHO
PROVEC (Progressive Vectors)	SDS Sigma 7	WOHO
Scrub (Data Edit and Correct)	SDS Sigma 7	WOHO
Sigmat	SDS Sigma 7	WOHO
S ONVEL (Sound Velocity)	SDS Sigma 7	WOHO
SPVOL	SDS Sigma 7	W OHO
STATS (Statistical Quantities)	SDS Sigma 7	WOHO
SVANOM (Specific Volume Anomaly)	SDS Sigma 7	WOHO
THISTO (Two -Dimen. Freq. Distrib.)	SDS Sigma 7	WOHO
THRCL (Thermometer Calibration)	SDS Sigma 7	WOHO
VECTAV (Vector Averages) '	SDS Sigma 7	WOHO
VEL (Geostrophic Velocity)	SDS Sigma 7	WOHO
VTR (Volume Transport)	SDS Sigma 7	WOHO
Q Factors	Atlas I	NIO
Raymor	Univac 1108	NUR DC
PASAL1 (Plot Temperature-Salinity)	IBM 1130	POG
TCHK3 (Thermometer Corr.)	IBM 1130	CODC

TABLE 14-3. GURC APPLICATION MODULES

Topographically Guided 4-Dimensional Analysis (TG4DA)
Character Analysis (Charanal)
Similarity Graph Clustering (Graph)
Species Diversity (Shannon-Weaver)
Facinal Affinity (Morisita-One)
Basic Statistics (BASTAT)
Sound Velocity (Wilson)
Azimuth and Range Finding (ARF)
EDMPAS Graphic Output (EGO)

TABLE 14-4. STAT PAC PROGRAMS

X-Y Calcomp Plot - STATPAC
X-Y Conversion, STATPAC
Plot STAT PAC
X-Y Printer Plot - STATPAC
Modified Correlation Matrix - STATPAC
Triangular Diagram Plot (C ERBER 622) of STATPAC Data
Merge STATPAC Data Sets
Pre-Plot Data Preparation - STATPAC
Fisher K-Statistics
Graphical Analysis - STATPAC
Analysis of Variance
Stepwise Discriminant Analysis for Two Groups
Standard Error Replicate Samples
Factor Analysis Preparation
Step forward Regression
General Regression (Step Backward)
Factor Analysis - STATPAC
Correlation Analysis
Spearman or Kendal Rank Correlation Coefficient - STATPAC
Serial Correlation in One or Two Dimensions
Orthogonal Polynomials for Surface Fitting
Cluster Analysis

15.0 RECOMMENDED IMPLEMENTATION

Based upon the assessment of user's requirements and the availability of hardware and software systems, a two-phase program is recommended for implementation of the proposed BLM OCS Data Management System. This program entails the selection of an existing computer hardware system as the host for OCS Data Management System development and pilot test, and the translation of the entire OCS System to a new BLM facility when it is operational and sufficiently configured to accommodate it. Prior to implementation, interim capabilities are proposed in order to provide BLM investigators with the ability to perform limited data analyses during the development time frame for the recommended system. In the sections below, these proposals are outlined. A preliminary implementation plan is also offered.

15.1 Hardware Systems

Computer hardware recommended for use by the OCS Data Management System consists of a centralized facility which contains and manages the OCS data base, and a series of batch or interactive terminals for users to access and update the data base from remote sites. Primary remote capability is recommended for OCS Regional Offices with constrained lesser capabilities at field offices and investigator's facilities.

An assessment of available hardware systems suggests that the IBM 360/ 65 at DOI Headquarters in Washington, D. C. would be sufficient to accommodate both data and user access demands during the short-term future. This machine is presently operated by the GS, but will become a general DOI service center July, 1975.

If the OCS Data Management Software were immediately available for installation, the GS IBM 360/65 would be the ideal host configuration considering its on-line storage capability, its present teleprocessing use, its proximity to BLM OCS Headquarters, its tie to the GS Center at Reston for compute r overload relief and the potential acquisition of GS platform data, and its convenience to the NODC facility

Unfortunately, no complete system currently exists which will satisfy all OCS data handling requirements. Therefore, some development period must necessarily precede system implementation so that it will not occur until sometime within the time frame scheduled for the installation of the second GS IBM 370/ 155 (July or August, 1975) and the release of the 'primary GS IBM 370/155 system in November or December, 1975. If all proceeds according to plan, the DOI machine will undoubtly be under a heavier loading than presently experienced owing to an overflow of users who potentially may not be able to run on the new, yet undefined GS configuration. This availability clouds the selection of the DOI machine for long-term OCS data base applications.

The second element influencing the recommendation of a target host for the OCS Data Management System is the planned BLM Denver facility reconfiguration scheduled to occur January, 1976. As previously indicated, the proposed BLM facility has been designed to service OCS needs through remote batch terminals installed at OCS regional offices and at the Washington, D. C. OCS Headquarters. Although present facility plans were defined for lease -related operations and without load and storage estimates for the OCS Environmental Studies application, it nevertheless represents a viable alternative for an OCS Data Management System host computer beyond the immediate time frame. (It should also be mentioned that a larger complement of BLM personnel with data management expertis e at the Denver Center also adds to its attractiveness s.)

In view of the difficulty to define the long -range availability of government data processing facilities, and the uncertain OC S Data Manage - ment System implementation period, it is recommended that the planned BLM Denver facility be selected as the ultimate target host computer for the OCS Environmental Data Management System. It is further recommended that the Data Management System be initially targeted for the DOI IBM

360/ 65 for system development and pilot test, and that the system be translated, in total, to the Denver facility when it is operational and sufficiently configured to accommodate the OCS system. (The proposed two-phase remote-centralized configuration is shown in Figure 15-1). The latter recommendation infers that the development be directed toward machine independence, a system requirement previously stated, and that cognizance of Denver configuration and software system plans be maintained throughout the development.

The detailed configuration of the B LM Denver facility is not defined at this time, although information available indicates its probable suitability for this application. The possibility exists, however, that the system may not be implemented or may be implemented in an unsuitable configuration for the OCS Data Management System. In either of these events, two alternative approaches exist; namely (1) continued use of the DOI IBM 360/75 as a host computer, or (2) translation of the system for the GS Res ton computer facility, assuming that it will be more suitable. The following discus sion addresses the primary recommendation (B LM Denver).

With respect to the growth in hardware equipment required to service increased Data Management System demand necessitated by the enlarged leasing program, an increasing user clientele, and a larger OCS data base resulting from completed baseline studies and an on-going monitoring program, Figure 15-2 illustrates a possible phased equipment acquisition program extending from the present time (1975) through 1980. Note that typewriter terminals are considered sufficient to handle contemporary regional office requirements, assuming that bulk data enters the data base via magnetic tape. As regional remote station requirements increase, this capability is enlarged to a remote batch terminal and finally a computational load distributive satellite processor system by FY 1978. Communications equipment at the central facility must also proportionally increase from a controller and dedicated channel to a large communications

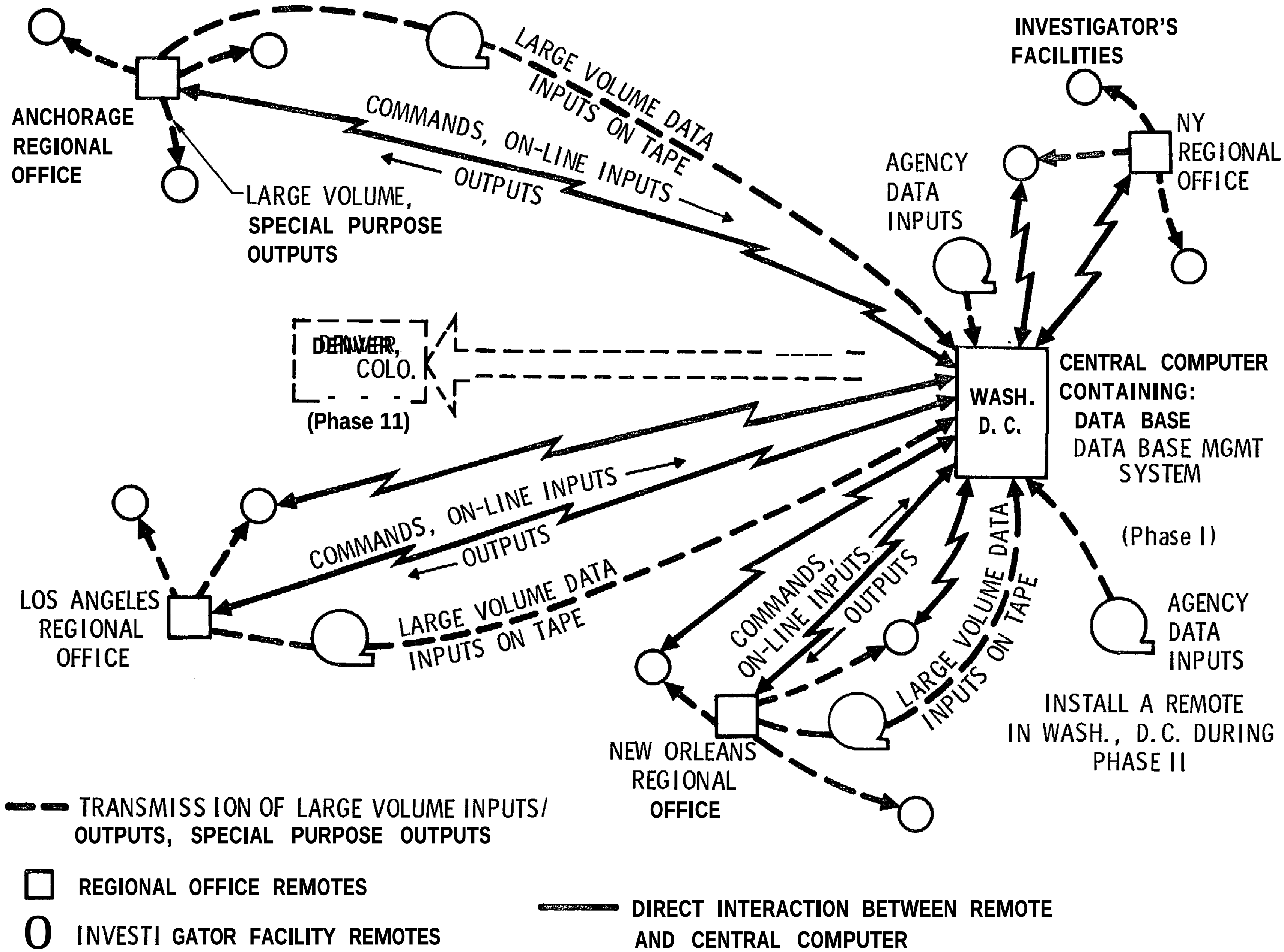


FIGURE 15-1. CENTRALIZEDBLM COMPUTATIC)NAL FACILITY

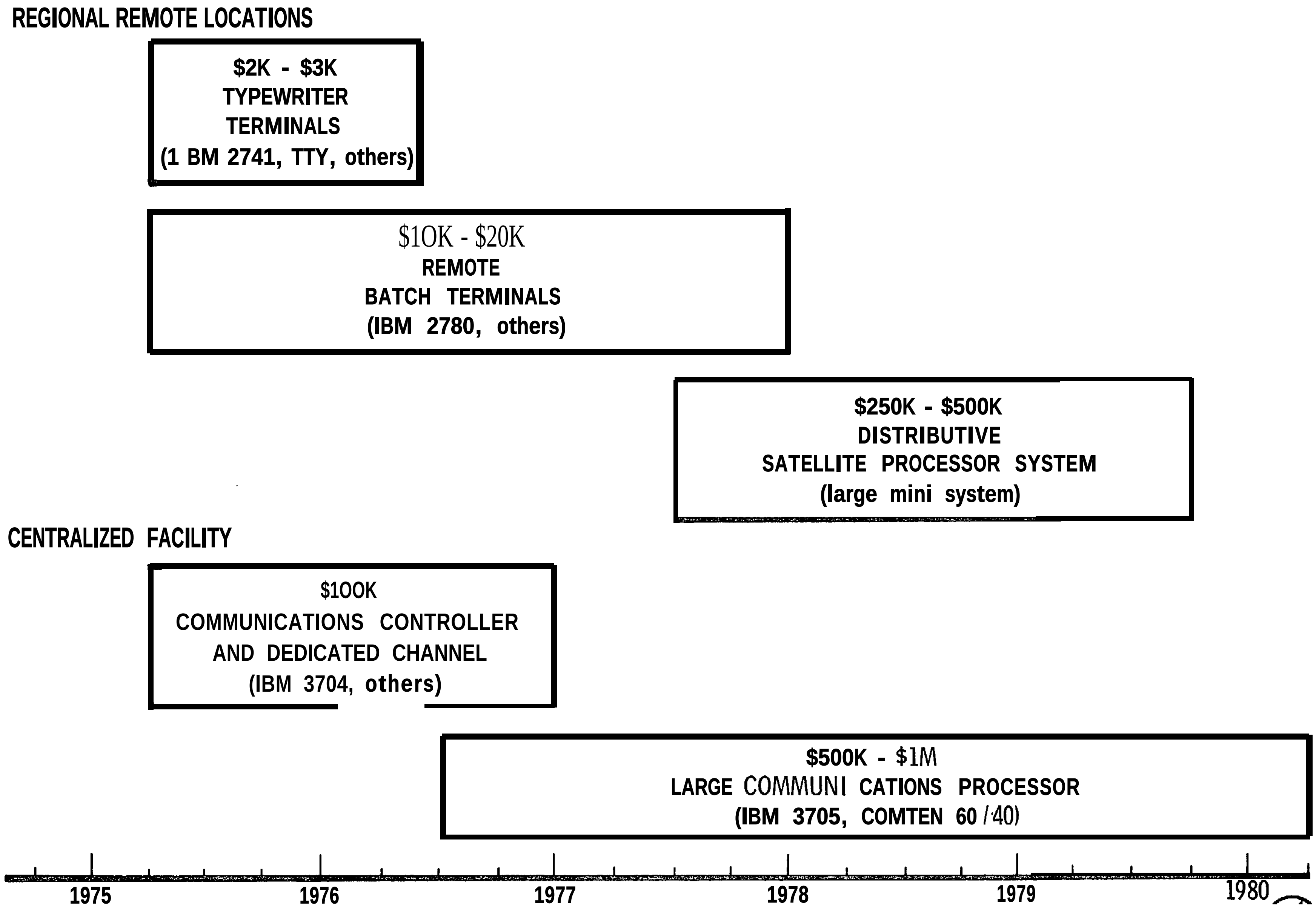


FIGURE 15-2. PHASED EQUIPMENT GROWTH

processor by FY 1977. Concomitant growth in remote peripheral devices, both standard and special purpose plot and graphic digitization systems, should also be expected during this period. (A detailed discussion of remote-terminal and communications process or options is provided in Appendix G).

As remote processor capabilities and load increase, it will also be necessary to increase the capacities of the data transmission channels to those remotes. The following tables (Table 15-1 and 15-2) address these issues. Also included, in Table 15-3, are estimates of transmission costs.

15.2 Software Systems

15. 2.1 Data Base Management System

As indicated in Section 13, the selection and use of SYSTEM 2000 for the OCS data base management system is firmly endorsed. This choice is the result of a comparative evaluation of the system's capabilities with the requirements of the B LM OCS Environmental Studies Program. SYSTEM 2000 capabilities are summarized below.

- Wide Usage for Environmental Data Systems by Gove rnment and Industry
- Versions Exist for CDC Cyber 70 Series, IBM 360/370 Series, UNIVAC 1100 Series
- Multiple File Handling
- Variable Length Records Through Data Set Definition
- Inverted File Capability
- Hierarchical Structure (64 Levels)
- Fortran and Cobol Interface Provided
- English-like, Free-form User Language
- Easily Accommodates New Applications
- Suited for Non-programmer Users

Although it is not certain the SYSTEM 2000 will be compatible with the computer to be installed in the B LM Derive r Center, owing to the fact that the configuration is yet to be defined, the transferability of SYSTEM 2000 and the increasing clientele of government users provides

TABLE 15-1. DATA EQUIPMENT SPEEDS

DP Equipment	Operating Speeds (bps)
Card Reader:	
300 cards /rein	3, 200
600 cards/rein	6,400
1000 cards /rein	10, 600
Card Punch:	
300 cards/rein	3, 200
500 cards/rein	5, 300
Paper Tape Reader	75 to 8, 000
Paper Tape Punch	75 to 2, 400
Printer:	
300 lines/rein	6, 000
600 lines/rein	10, 000
1000 lines/rein	19, 400
Typewriter	45 to 150
CRT	8, 000
Magnetic Tape Unit	150 to 2,720, 000
Disk Units	1,248, 000 to 2,496,000
Drum Units	1, 000, 000 to 8, 000, 000
CPUS	2, 000, 000 to 16, 000, 000

TABLE 15-2. DATA TRANSMISSION CHANNELS AVAILABLE

Channel Bandwidth	Description	Transmission Capacity (bps)
3 kHz	Voice and data channel switched network	4,800
3 kHz	Voice and data channel leased line	9, 600
48 kHz	Broad band data channel leased or switched	50,000
240 kHz	Broad band data channel, Series 5000 C leased only	250, 000
960 kHz	Broad band data channel, Series 5000 D leased only	>500,000
4.6 to 10 mHz	Video channel	up to 20, 000, 000

TABLE 15-3. DATA TRANSMISSION COST ESTIMATES
(1974 - GSA CONTRACT)

Transmission Capacity	Termination Cost ($/Month)	Line Cost ($/Month/Mile)
9, 600	650	.40
19, 200 (2 x 9, 600)	1300	.80
19, 200	850	2050
50, 000	850	5* 00
100,000 (2 x 50,000)	1700	10.00
234, 000	1350	30.00

Note: The total cost per month of a channel is given by:

total cost = termination cost + (line cost) x (length in miles).

some assurance that compatibility will be achieved. Its present computer usage flexibility far exceeds those of the other systems considered. It should also be mentioned that SYSTEM 2000 is presently available on the GS IBM 360/370 configurations. Based on this availability, we believe that it can be used to support the "initial" development system effort without cost.

15. 2.2 Functional and Utility Processors

Oceanographic functional analysis programs can be categorized as follows:

- Biological Oceanography
- Chemical Oceanography
- Geoscience (Marine Geophysics and Sediment Analysis)
- Physical Oceanography

Available programs in these categories were identified in Section 14 as potential candidates for BLM's functional processor library on the basis of their applicability to oceanographic analysis and their adaptability y with the Data Management System. It is recommended these programs be reviewed and a set be selected for the initial functional processor library by an advisory group of users who are familiar with BLM analysis and special study requirements. Additional processors satisfying the program language criteria established in Section 14 can be added upon user demand.

Limiting the discussion to programs known to be acceptable according to program language criteria, it is recommended that a general graphics display package and a comprehensive statistics program library form the initial utility processor library. Acceptable plot packages are found in the GURC, NODC and WOHO libraries. Recommended systems are:

• General Plot Program (EGO)	GURC
• Inventory Data Plot	NODC
• Map Projections and Grids	NODC

- Bar Histograms (HISTO) WOHO

Statistical packages are numerous and, for the most part, readily available. However, none of the evaluated oceanographic and water quality data systems have a package considered sufficiently capable to satisfy BLM requirements. Viable candidates for the initial processor library include the Geological Survey's STATPAC programs, the UCLA BMDP program series and the University of Chicago SPSS programs. These systems should be reviewed in more detail before final selection,

15.3 Interim Capability

During the development and system test of the proposed Data Management System any environmental baseline or monitoring data gathered by field investigators, such as the SUSIO MAFLA study, will not be available for automated manipulation and analysis. Considering the dynamics of current surge for energy independence, any time lost waiting for anal ys is capability will be too long. It is, therefore, proposed that an interim arrangement utilizing an existing oceanographic system be established to service investigator's current processing needs. It is assumed that any system selected for interim use would not be modified to accommodate specific BLM OCS requirements.

Two possible arrangements exist: The use of the GURC facility or that of NODC. Either situation has its advantages and disadvantages. These were addressed in Section 12. The possibility of using EPA's STORET system was rejected because of its complexity, its lack of oceanographic proces sing capability and the fact that OCS data, once stored in the STORET cannot be readily transferred to the ELM OCS data base without an expended effort that could not be recouped by later application. The possibility of entering OCS data within the Westinghouse system was also set aside because of the lack of information defining its oceanographic and data processing capabilities. Receipt of more substantive material in these areas could change this position.

Use of GURC's total system on short-term interim basis seems to present the best alternative. The GURC system contains enough flexible investigator-oriented processing capabilities that its data management deficiencies will not be apparent if its use is restricted to a small data base such as the current MAFLA baseline study. Although any data base constructed under the system will not be directly usable by the ultimate BLM OCS system, their simple, sequential structure will permit a fairly straightforward conversion. The GURC system can also be used as a test bed for FORTRAN software that will be added to the OCS processor library. Recall that SYSTEM 2000 presents retrieval users with a sequential data file for their subs equent manipulation. This is not inconsistent with the GURC system use of sequential information. GURC's present remote capability also enhances the position of this alternative.

An interim application of the NODC system will also permit users to have access to their data in an automated sense. The difficulty, however, is that users would have to be content with the processing the NODC system currently provides. This is quite limited. A mixed bles sing can be found in the conversion of BLM OCS data to NODC's formats. Once in the NODC system, data cannot be easily translated to the BLM OCS data base without a considerable effort. However, NODC presently has data which should be added to the BLM OCS data base. Further, the NOAA Gulf of Alaska study will gather data which is also required in the BLM OCS data base. Ultimately, translation software will have to be written to accommodate NODC stored information. Therefore, the software development time required for data base translation can be rationally accepted.

The current NODC system will not accommodate all types of environmental data to be gathered in baseline studies. Physical oceanography data is fairly well represented, but chemical oceanography data handling is limited. Some biological data can be stored, but geological and geophysical data is not represented unless the NGSDC capability is also used. Some still existing deficiencies are alleviated with the addition of proposed MESA data formats (including in Appendix D), but the extent that NODC or EDS systems will manipulate this information is unknown. Similarly, the success of NODC's field remote implementation is unknown at this point.

A policy decision by the BLM OCS Environmental Studies Program is required to choose between the GURC and NODC interim alternatives.

15.4 Implementation Plan

To implement the proposed system, a detailed plan is required. This plan should consider the following:

- The circulation of this system definition to BLM OCS regional and headquarters staff to elicit their comments concerning the proposed system.
- Meetings with BLM office representatives (a designated advisory group) should be held to resolve the following design-level policies:
  - The computational requirements of their respective organizations.
  - The definition of data base structure and content considering anticipated retrieval and analysis requirements. These meetings should be preceded by consultation with the Geological Survey (Water Resources Division) for their guidance and the benefit of their experience using SYSTEM 2000 in District Office bench mark tests. Westinghouse Oceanic Laboratory should also be consulted for their SYSTEM 2000 experience.
  - The user specification language structure and vocabulary.
  - The data input formats consistent with defined data base set convention. Standards must be established for off -line data inputs and on-line keyboard inputs. (A free-form input technique is favored for Data Management System inputs in which only parameter type and order need be defined).

- The external data tape formats that the System will attempt to translate and the tape formats that the System will generate for data distribution to external users and agencies. A review of existing NODC and MESA formats (included in Appendix D) should be made to determine whether they will suffice.

- The translation of the MAFLA data into the approved input format to be used as a system test data base.
- The preparation of detailed system and system interface specifications.
- The preparation of specifications for unavailable software systems including user specification processor, execution supervisor, data input translation processor and data tape preparation/translation processors.
- The specification of required remote hardware configurations.
- The estimated development effort duration and scope.
- The acquisition of designated software components and system implementation using the IBM 360/75 as an interim host computer with the BLM Denver configuration as its utlimate hardware system. Close agency coordination should necessarily accompany this development with a continual review and consideration of changing user's needs and representation in Denver Center planning.

APPENDIX A

OCS BACKGROUND INFORMATION

1.0 OUTER CONTINENTAL SHELF

The continental shelf of the United States varies in width from a few miles off Miami to more than one hundred miles seaward of New England and along the Gulf Coast. Between Alaska and Siberia the continents of North America and Asia merge to form a continental shelf that floors the entire Bering Sea.

The configuration and slope of the shelf varies greatly from place to place. The Atlantic shelf from Long Island south to Florida slopes gently seaward to about 200 meters where it drops off abruptly on the continental slope. Submarine canyons frequently cross the outer shelf but none reach all the way to the shoreline. North of Long Island, the shelf is covered with sand and gravel bank areas which are remnants of glacial activity.

The Gulf Coast continental shelf is similar to the Atlantic shelf in width and configuration. It is dominated by the Miss iss ippi Rive r delta and its uncle rwater sediment cone. The thick wedge of sediment that comprises the Gulf Coast shelf has been a rich oil and gas bearing source for almost 50 years, and promises to yield even greater volumes of hydrocarbons in the future.

Pacific coast continental shelf areas are very complex and irregular being broken by faults and basinal features along the entire length. The seaward termination is abrupt and precipitous and is considerably deeper (up to 400 meters) than either the Gulf or Atlantic shelves. Both oil and gas have been recovered from the offshore areas of California, mostly in the Channel Islands area near Santa Barbara. Substantial exploitation in this area has been slowed as a result of the oil spill disaster in January of 1969.

One of the most promising offshore areas for oil and gas production is off the north slope of Alaska. Massive reserves have been discovered in the nearshore and immediate onshore regions of the north slope and it is likely that these petrochemical-bearing formations extend seaward

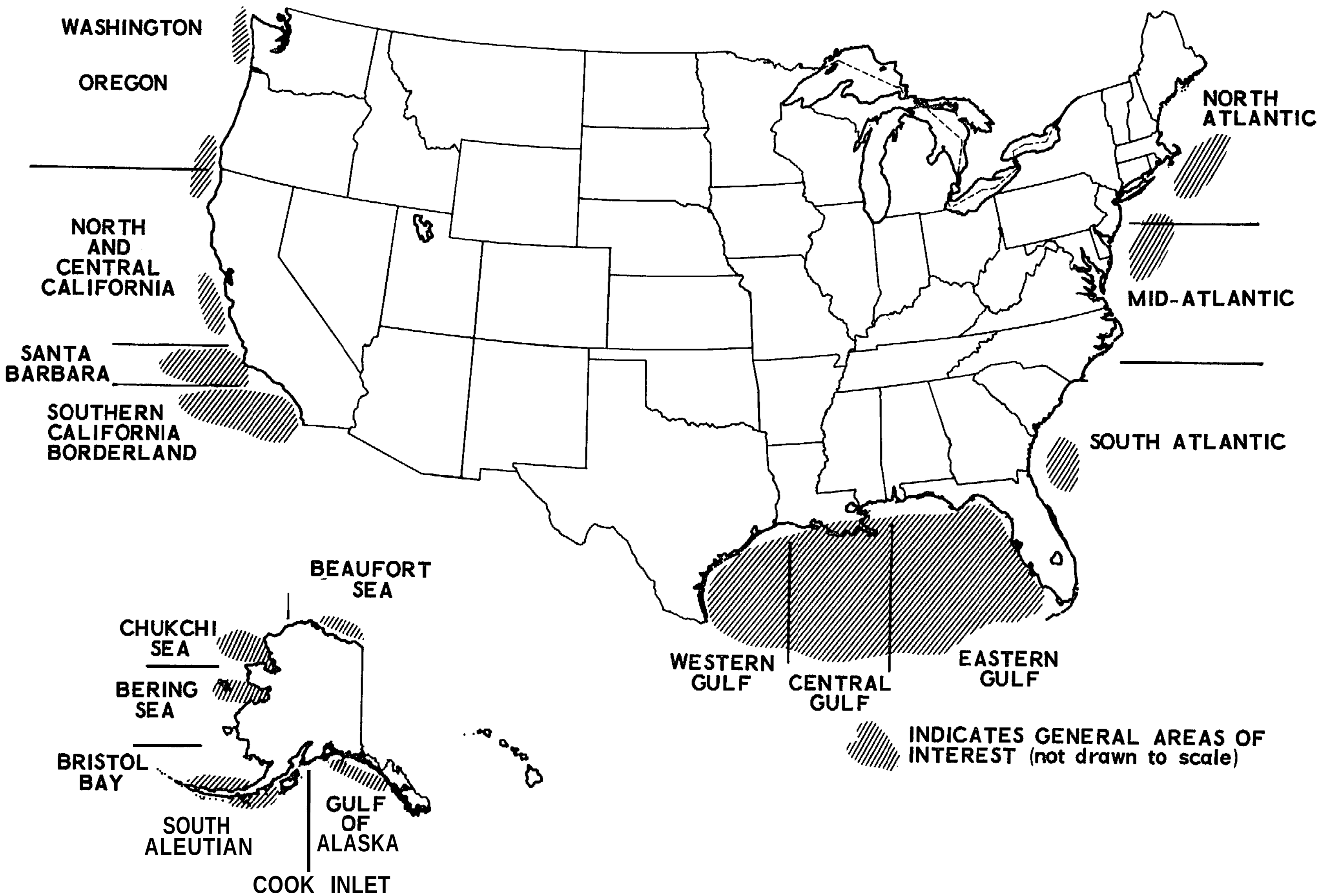


FIGURE i-1. OCS REGIONS OF INTEREST FOR OIL GAS EXPLORATION uncle r the continental shelf.

The total area of the continental shelf of the United States out to a 200 meter depth amounts to more than 853, 000 square statute miles, which is roughly equal to one-third of the dry land mass of the U. S. If the continental slope, the submerged area between 200 and 2, 500 meters depth, is included the total amounts to approximately 1, 332, 000 square statute miles.

2.0 AGENCIES INVOLVED IN OCS PROGRAM

Federal jurisdiction over submerged continental margins was originally based on a 1945 proclamation by President Truman in which he stated that 'jurisdiction over the natural resources of the subsoil and sea-bed of the continental shelf by the contiguous nation is reasonable and just. ., "

The Truman Proclamation was further defined in 1953 by the passage of two acts. The Submerged Lands Act (67 Stat. 20) granted to all coastal states jurisdiction of submerged coastal lands up to a distance of three geographical miles seaward of their coastline, and extended to each state bordering on the Gulf of Mexico, based on historical boundaries, the opportunity to prove entitlement to as much as 3 marine leagues (10.4 statute miles) in Gulf waters. (Only Texas and Florida of the five Gulf states have elected to do so). Also in 1953, the Outer Continental Shelf (OCS) Lands Act (67 Stat. 462) established Federal jurisdiction over the submerged lands of the continental shelf seaward of the state boundaries. The Act charged the Secretary of the Interior with the responsibility for the administration of the mineral exploration and development on the OCS. It also empowered the Secretary to formulate regulations so that the provisions of the Act might be met.

The 1958 Geneva Convention, formulated and signed by the United States, established continental shelf jurisdiction in international law. This treaty sets the legal coastal nation jurisdiction over the continental shelf at 200 meters or, ". . . beyond the limit, to where the depth of the super jacent waters admits of the exploitation of the natural resources." Forty nations were signatories to this treaty and almost one hundred coastal nations have since asserted their rights over minerals in the contiguous continental shelf areas.

2.1 B LM Responsibilities

Subsequent to the passage of the OCS Lands Act of 1953, the Secretary of the Interior designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged federal lands, and the Geological Survey for supervising production. The Secretary formulated three major goals for the comprehensive management program for marine mine rals. These are:

- The orderly development of the marine mineral resources to meet the energy demands of the nation.
- The protection of the marine and coastal environment.
- The receipt of a fair return for the leased mineral resources.

These leasing objectives are based on the following legislative mandates:

- Orderly resource development is based on the OCS Lands Act which gives the Secretary the authority, in order to meet the urgent demand for oil and gas, to grant leases to the highest qualified bidder(s) on the basis of sealed competitive bids. Hard minerals such as sand and gravel are also subject to leasing in the same manner.

- Protection of the marine and coastal environment is a dire ct outgrowth of the National Environmental Policy Act of 1969 (PL 91-90), Section 102 (2)(C) et seq. which requires that all Federal agencies to utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences in any planning and decision-making that may have an impact on man's environment.

- Receipt of fair market value has basis in two separate mandates. United States Code 31, Section 483 (a) obligates the Federal Government to obtain a fair return for public lands that are sold or leased. This is further implemented within the Executive Branch by Bureau of the Budget Circular A-25.

B LM and the Geological Survey ensure the orderly development of OCS lands by selecting specific tracts for leasing based on their assessment of industry development capability, competition, timely future availability of resources to consumers, environmental risk, as well as additional geologic, geophysical, and engineering data.

To evaluate the environmental risk, the Bureau prepares an Environmental Impact Statement for eve ry lease sale in compliance with the National Environmental Policy Act which requires all Federal agencies "include in every recommendation or report on proposals for legislation and any other Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on the environmental impact of the proposed action. . . . " The act further requires that agencies define the following for each proposed action:

(1) the environmental impact of the proposed action;

(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;

(3) alternatives to the proposed action;

(4) the relationship between local short-term uses of man's envi ronment and the maintenance and enhancement of long-term productivity; and

(5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Preparation of impact statements is coordinated with contact people in key Interior agencies such as Geological Survey, Fish and Wildlife Service, National Park Service, Bureau of Outdoor Recreation and Bureau of Mines as well as outside agencies in the Departments of Transportation and Commerce and the Environmental Protection Agent y. As a r e suit of imps ct statement evaluations, specific tracts may be withheld from the sale because the environmental risk ass ociated with their exploration and exploitation is too great. Tracts that are more sensitive environmentally, but which can be developed uncle r adequate lean stipulations are also defined by the EIS.

Receipt of fair market value, the Department's third goal, is achieved through mineral resource estimates and a pre-, post-sale analysis. Prior to a lease sale, data on the mineral reserves in a given area is gathered from Geological Survey and independent contract studies. This info rmation, along with inputs of capital and operating expenses, discount rates, and procedures to follow in calculating taxes, is used by GS to calculate pre-sale tract values. Following a sale, the BLM conducts a post-sale analysis of high bids to assist the OCS Manager in his determination of whether particular leases should issue.

2.2 Other Agency Responsibilities

During the preparation of environmental impact statements preceeding OCS tract lease, B LM coordinates its investigation and preparation activities with various agencies within the Department as described above. Upon completion of a draft, EIS review and comments are specifically requested from the following Federal agencies, as well as agencies from affected states.

Geological Survey
National Park Service
Fish and Wildlife Servie
Bureau of Outdoor Recreation
Bureau of Mines
National Marine Fisheries Service
Environmental Protection Agency
Department of Transportation
Federal Power Commission
Federal Energy Administration

In pre - sale evaluation, the Geological Survey has the responsibility for calculating the resource value of each OCS tract with BLM performing an audit and review function. GS is also responsible for collecting and analyzing the geologic, geophysical, and engineering data which may be either purchased from contractors and/or obtained from industrial sources to support these resource calcualtions.

Once competitive bidding has been completed for a lease tract, a post -evaluation is conducted to determine the highest responsible qualified bidder from each tract, and to ensure that the Federal Government receives fair market value for each tract bid upon. This function is performed by both BLM and GS.

After a lease bid is accepted, supervision of the lease operation is assigned to the GS, but B LM retains the overall responsibility for protection of the OCS land. Operation plans must be submitted by lease operators and approved by the GS before each stage of operations (exploration, development and abandonment) is initiated. Approval of all operations must be obtained prior to their commencement.

Once operations are initiated, the operator is required to inspect all aspects of the safety systems associated with his equipment at specified intervals and to prepare detailed record of these inspections. These requirements are enforced by the GS who perform irregular on-site inspections to verify compliance. Operators are required to report all spills or leakage of oil to the GS without delay. They must also notify GS of any unusual condition, problem or malfunction within 24 hours. Waste disposal regulations are also enforced by the GS who peform surveillance of operational sites by helicopter "fly-overs" and on-site inspections.

The OCS responsibilities of other agencies are summarized below:

(1) Department of Transportation

U.S. Coast Guard -- Responsibilities for:

(a) ensuring that structures on the OCS are properly marked to protect navigation;

(b) establishing and enforcing safety regulations on these structures;

(c) maintaining surveillance during all cruises and over-flights of the OCS for spilled or dis charged oil; and

(d) inspecting and certifying all floating drilling rigs except those which rest on bottom during drilling.

Office of Pipeline Safety (OPS) -- The OPS has general responsibilities for pipelines. It primarily supervises gas pipeline safety, including the establishment of design criteria directed toward increased safety.

(2) Environmental Protection Agency (EPA)

The EPA has several functional responsibilities in the OCS leasing program. It is directly involved in the critical review of the draft environmental impact statement, for which it provides extensive, sub-s tantive comments.

The EPA is required by Section 403 of the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 to establish standards uncle r which a permit for discharge of pollutants into navigable waters of the U. S. may be issued. While this responsibility has not yet been tested, and the re is some controversy concerning the applicability of the Amendments to the OCS beyond the contiguous zone, the EPA could eventually yield a high degree of control over ope rations on offshore structures.

The EPA, along with the Departments of Interior, Trans-portation, and Defense, are designated the four primary Federal agencies responsible for the organization, management, design or response, and actual response to polluting incidents under the National Oil and Hazardous Subs tances Pollution Contingency Plan, which was incorporated into the FWPCA Amendments of 1972. The EPA is also a member of the OCS Research Management Advisory Board which will be described in {9) below.

(3) Corps of Engineers, U.S. Department of the Army

The authority of the Secretary of the Army, which is delegated to the Corps of Engineers, ". . . to prevent obstruction to navigation in the navigable waters of the United States is hereby extended to artificial islands and fixed structures located on the Outer Continental Shelf, " is derived from Section 4(f) of the OCS Lands Act. In general, since the Coast Guard regulates above water structures, Corps responsibility has been taken as permitting of structures and pipelines. The Corps requires that pipelines crossing shipping lanes be hurried to a depth of 10 feet.

(4) Federal Power Commission (FPC)

The FPC has discretionary powers over the approval, design and economics of common carrier gas pipelines. It also determines what the price of OCS gas will be at the wellhead. This regulated price is the base price from which the final price is determined, after costs and profit have been added. The FPC also is solicited for review and comment of draft impact statements on lease sales. The FPC is sues the certificates of public convenience and necessity that are necessary for gas pipeline cons truction.

(5) Fish and Wildlife Service (FWS)

The FWS (formerly the Bureau of Sport Fisheries and Wildlife) has a broad mandate to study, protect and manage fish and wildlife resources. In the offshore environment, these resources include sport fish, marine mammals, and marine birds. On-shore, FWS is concerned with fish and wildlife and the habitats where they abide, as well as numerous refuges under FWS jurisdiction. In the leasing program, the FWS primary role is that of a reviewing agency for draft impact statements. FWS has also participated in the design of several OCS related study programs sponsored by BLM, and is a member of the OCS Research Management Advisory Board.

(6) Federal Energy Administration (FEA)

The FEA has broad discretionary powers over matters pertaining to energy supply and demand in the U. S. The FEA has been given the directive to implement and monitor the progress of Project Independence, among numerous other duties, and is making strides at understanding and monitoring the OCS leasing program. FEA was recently added to the list of agencies which are solicited for review and comment of OCS leasing impact statements.

(7) National Oceanic and Atmospheric Administration (NOAA)

The NOAA, in the Department of Commerce, has broad jurisdictional powers over many aspects of the marine environment. Historically, the prime involvement of NOAA in the OCS leasing program has been through the National Marine Fisheries Service (NMFS), which extensively reviews and comments on draft impact statements. The NMFS is concerned with all types of potential impacts on marine fish, especially commercial fisheries. The NOAA has a representative on the OCS Research Management Advisory Board, and is undertaking the environmental baseline studies being sponsored by BLM in the Gulf of Alaska.

(8) State Agencies

In general, the OCS Lands Act withdrew most control over OCS oil and gas production from coastal state jurisdiction. However, physical, chemical, geological, and biological provinces and habitats overlap Federal - State boundaries, and thus the coastal states have an interest in offshore activities that might affect their coastal resources. In addition, there are obvious economic benefits and disbenefits to a coastal state as a re suit of offshore development in the forms of construction equipment, refinery employment if refineries are in existence or proposed, and host of related services, secondary employments and income to the state.

(9) OCS Research Management Advisory Board

On March 20, 1974, the Secretary of the Interior established the Outer Continental Shelf Research Management Advisory Board under the provisions of the Federal Advisory Committee Act. The objective of the Board is to advise the Assistant Secretary - Land and Water Resources, the Dire cto r of the Bureau of Land Management, and other offices of the Department, in the des ign and implementation of environmental research projects related to oil and gas exploration and development on the OCS.

The formally instituted Board is an outgrowth or an inter-agency ad hoc committee that began meeting in January, 1974, for the purpose of designing the baseline study to be conducted on the Mississippi, Alabama, Florida (MAFLA) OCS. As the s cope of future baseline and monitoring studies was expanded and a commitment of funds were made to the Department from the Office of Management and Budget, the need for a chartered Board becomes apparent.

In general, the charter calls for the Assistant Secretary - Land and Water Resources to appoint a Department of Interior employee as Chairman of the Board, after consulting with the Assistant Secretary - Energy and Mine rals, and the Assistant Secretary - Fish, Wildlife, and Parks. Each of the following Government agencies appoint one member: Geological Survey, Fish and Wildlife Service, Environmental Protection Agency, and National Oceanic and Atmospheric Administration. In addition, a provision is made for each coastal State adjacent to OCS areas for which environmental studies are planned to be a member of the Board. A Chief Scientist for the BLM OCS environmental research program will attend all Board meetings, or send a representative. It is intended that the members of the Board be scientists, or administrators who are familiar with ocean research and the design of large-scale environmental studies. These studies, primarily the monitoring aspect, are expected to continue for approximately ten years.

3.0 PROPOSED INCREASED LEASING PROGRAM

The Presidential directive to lease 10 million acres of Federal OCS lands in 1975 represents more than tripling of the acreage currently offered annually for lease by private industry. The directive represents a significant change in Federal Government policy concerning the development of domestic OCS oil and gas resources. The proposed increased leas ing program seeks to significantly expand the Nation's domestic oil and gas energy supply, as long as this can be done in an environmentally safe manner and in a manner that insures fair market return to the Federal Government for allowing these lands to be developed as sources of energy.

The scope of this proposed action is wide-reaching. Currently, the Nation's entire supply of domestic OCS oil and gas comes from the Gulf of Mexico, specifically the Texas -Louisiana OCS. If the indications of declining oil and gas production prospects in the Gulf are accepted as valid, then a significant expansion of acreage offered would not, if offered in the Gulf alone, result in increased production of OCS oil and gas resources for our domestic needs. Therefore, this expansion to 10 million acres of leased OCS land in 1975 must include geographic areas of the United States that have experienced little or no history of offshore oil and gas operations. These frontier areas include the Atlantic coast, lower 48 Pacific coast, and the coast of Alaska. The Atlantic and Alaska OCS areas have no history of drilling activity; Alaska has State coastal water development in Cook Inlet, but the Atlantic waters belonging to the coastal states do not currently produce any oil or gas. There has been some development of the coastal and OCS waters of Southern California; however, drilling on Federal Lands have been suspended since the Santa Barbara blowout and oil spill in early 1969.

The opening of frontier areas to OCS oil and gas leasing is a proposal that, if implemented, will result in significant changes in physical, social, and economic environments, as well as an expansion of management, supervisory, and monitoring systems within Federal and State governments. In the development of the proposed and accompanying five -year provisional lease schedule, the Department considered its three leasing objectives; orderly resource development, protection of the environment, and receipt of fair market value. These objectives constitute overall policy parameters for the OCS program. Certain elements of the current OCS leasing program will carry over and be applied to an expanded program. Development in any frontier area will not begin until Operating Orders, similar to those used in the Gulf of Mexico, are developed for the specific geographic area. Current regulations and inspection programs will be applied to frontier development.

Under the current three million acre-per-year schedule, frontier areas were scheduled to be opened in Southern California and Alaska. In response to this, the Bureau of Land Management, in August and September, 1973, respectively, opened field offices in these two areas with responsibilities for collecting physical and socio-economic information, conducting environmental analysis on proposed development in the respective areas, and performing all functions attendant to leasing lands in those areas. An Atlantic OCS Office was also established in December of 1973 with the purpose of environmental assessment of the area, but without a leasing function, as leasing on the Atlantic coast was contingent on the Council of Environmental Quality's assessment of the impact of oil and gas development in the area (released April, 1974), and is contingent on the resolution of current litigation against development brought by several coastal states against the Federal Government.

The schedule for OCS development indicates a sale for the Mississippi, Alabama, and Florida (MAFIA) sale in 1973. This is a frontier area with no history of OCS oil and gas operations. Opposition to that proposal was extremely vocal, especially from the public and institutional sectors of Florida. This opposition elicited a major commitment from the Department of the Interior to begin a comprehensive environmental baseline and monitoring study of the effects of OCS oil and gas operations in this area. The initial contract for the baseline data collection (which has been completed) was awarded to the State University System of Florida Institute of Oceanography (S USIO). During the development of the MAFLA study program, the Department, with a multi-million dollar commitment from the Office of Management and Budget, expanded the plans for environmental baseline and monitoring studies to include other frontier OCS areas of the United States. Study plans are currently being developed for the South Texas, Gulf of Alaska, and Southern California areas.

Subsequent to President Nixon's directive to lease 10 million acres in 1975, the Bureau of Land Management issued a request for comments on potential future OCS oil and gas leasing.

These comments were to be directed toward providing information concerning areas of interest for offshore oil and gas leasing and toward identifying problem areas. Seventeen areas were designated which encompass the OCS of the conterminous United States and Alaska. It was requested that these areas be ranked for oil and gas potential, and for environmental concern.

The BLM request for information is the first tier of the Department's newly developed two-tie r nomination sys tern, whereby the most promising offshore areas are better identified through earlier release of industry rankings and interest, and the public interest in different geographic areas is also made known earlier in the leasing process. The second tie r of the system involves analysis of rankings and public comments, the Department's own evaluation of resource potential and the impacts of development on the environment, and the nomination and selection of tracts within specified geographic areas for possible leasing. This is followed by the currently employed phases of the leasing system: a site-specific draft environmental impact statement, public hearings in the affected area, Federal and State agencies and public review of the impact statement in which all the various inputs are summarized and from which conditions and stipulations of the lease sale are formulated.

In addition to the two-tier nomination s ys tern, the B LM and USGS are exploring various options whose intent would be to require earlier release of geological and geophysical information in areas designated for lease sales. This information would be especially valuable in areas on non-production, as producing areas do not require as much geotechnical information to evaluate current prospects. The proposals for early information release are complicated by the historically proprietary nature of such information, bearing as it does on the competitive nature of lease acquisition and tract development.

The B LM, as well as other management and policy offices of the Interior Department, has been able to keep pace somewhat in its staffing needs in minerals management, Field offices in the four major OCS regions (Atlantic, Gulf of Mexico, Pacific, and Alaska) have been established and are either adequately staffed or are in the process of becoming so. The USGS, on the other hand, has the bulk of the supervisory responsibilities for OCS operations. As such, it must adjust its staffing needs in accordance with the current and near -term needs of the supervisory program. Supervision of operations that would take place on an expanded scale (both spatially and in intensity) under the 10 million acre leasing proposal must be signigicantly expanded. Requests for funding to support an increased staff in response to the possibility of an expanded leasing program have been proposed.

APPENDIX B

MAFLA OCS BASELINE DATA SIZING

MAFLA OCS BASELINE DATA SIZING

The data gathered by SUSIO in the MAFLA area consists of approximately 150, 000 items of information. This data contains both alphabetic (text) and numeric quantities in two basic types:

(1) Primary data resulting from observations and the on-board or laboratory analysis of gathered samples.

(2) Support data --cruise number, station number, geographic location, date, time, responsible investigator, etc.

The MAFLA data base was defined from sampling information extracted from SUSIO Final Report on the Baseline Environmental Survey of the MAFLA Lease Areas. In some cases approximations of data entries were made from summary information. The data entries were known to have been enumerated in various monthly SUSIO reports, but those reports are not available to us at this time.

The MAFLA baseline sample estimate was derived from the following information:

Benthic

(1) Biota -- 260 types of sponges, 24 types of hard corals, 19 types of soft corals, 50 types of echinoderms, 104 types of crustaceans, 108 types of molluscs, and 154 types of algae were categorized resulting in 1675 data entries.

(2) Foraminifera -- 193 species were categorized resulting in approximately 3000 data entries.

(3) Micromolluscs -- 85 species and 1340 data entries.

(4) Polychaetous Annelids -- 190 species and 3687 data entries.

(5) Macrofauna Biomass -- 5 species and 230 data entries.

(6) Adenosine Triphosphate (ATP) --260 data entries.

(7) Trace Metals from Benthic Organisms -- 880 data entries.

(8) Trace Metals from Sediment --456 data entries.

(9) HMW Hydrocarbons from Sediment --2060 data entries.

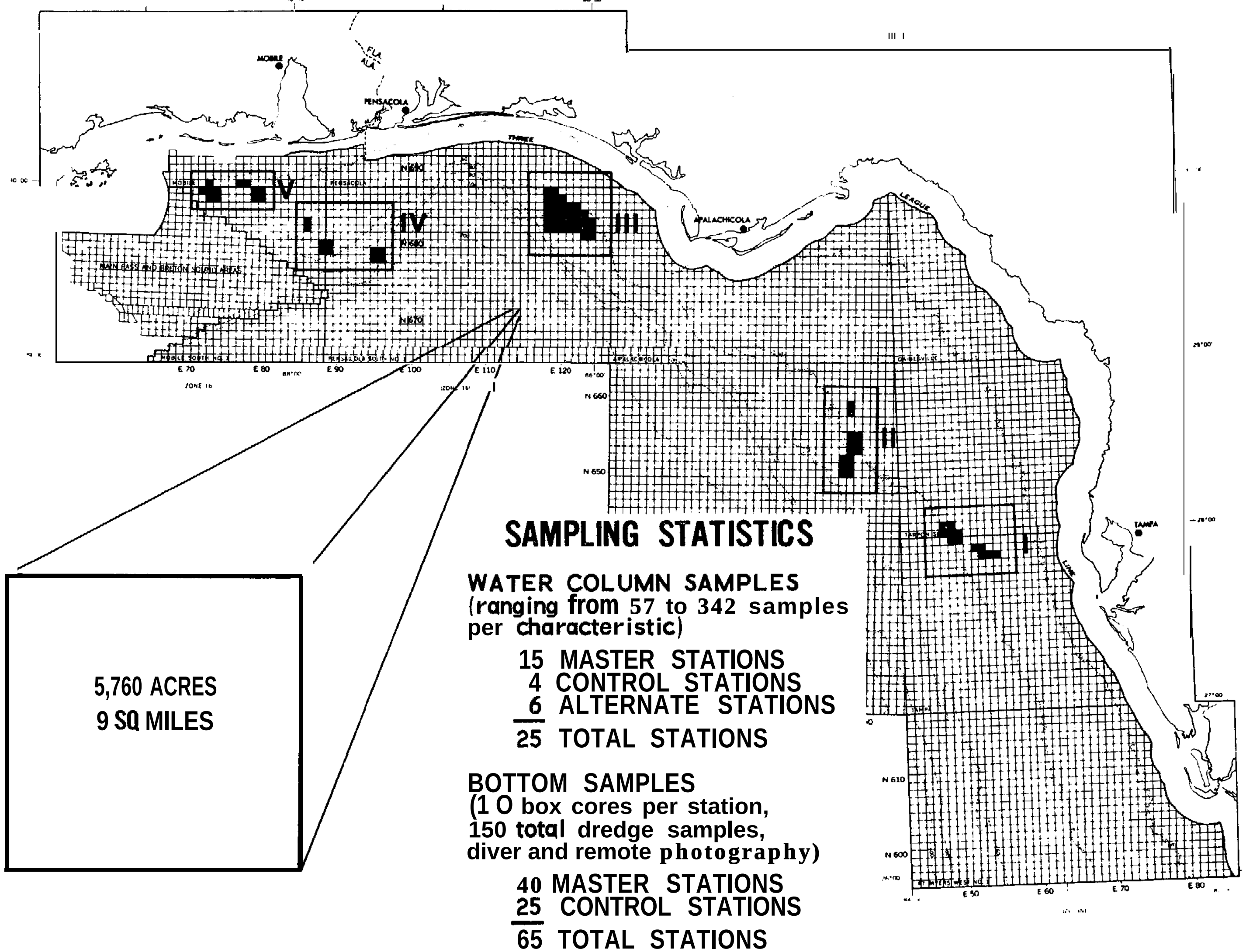


FIGURE 1-1. SAMPLING OF MAFLA TRACTS

(10) Core Descriptions .- 2600 data entries (text and numeric al).

(11) Vane Shear -- 1950 data entries.

(12) Grain size and Percent Carbonate -- 3900 data entries.

(13) Clay Mineralogy --520 data entries.

(14) Carbonate Sediment -- 10236 entries (test and numerical).

Water Column

(1) Phytoplankton -- 144 species and 3850 entries.

(2) Nannoplankton -- 100 species and 2604 entries.

(3) Chlorophyll --1980 entries.

(4) Zooplankton -- 33 species and 5346 entries.

(5) Adenosine Triphosphate (ATP) -- 162 entries.

(6) Particulate and Dissolved Organic Carbon -- 168 entries.

(7) Trace Metals (Suspended Matter) --336 entries.

(8) Trace Metals (Zooplankton) --792 entries.

(9) Trace Metals (Dissolved) --504 entries.

(10) Nutrients -- 264 entries.

(11) LMW Hydrocarbons --726 entries.

(12) HMW Hydrocarbons (Dissolved) --600 entries.

(13) HMW Hydrocarbons (Zooplankton) --600 entries.

(14) HMW Hydrocarbons (Particulate) -- 1450 entries.

(15) HMW Hydrocarbons (Algae) --500 entries.

(16) Dissolved Oxygen -- 117 entries.

(17) Salinity/Temperature/Depth Sensor (STD) -- 28800 entries (read every meter of depth).

(18) Expendable Bathythermograph (XBT) --
18400 entries (read every meter of depth).
920 entries (read at standard depths).

The above figures reflect a summation of only primary data entries. Absent are entries from histopathological analysis (not yet completed), current data (none taken) and physical geology (none taken).

Coded tables, directories, data management pointers, etc. , are estimated to enlarge the data base approximately by 50% to 225, 000 items. However, the final size of the MAFLA OCS data base depends on the answers to many questions, some of which are addressed below:

(1) Will temporarily relative or historical data (climatic, seismic, current, etc.) be gathered from other existing data bases and incorporated within the OCS data base or will it be treated separately?

(2) Will the prodigious use of the "inverted file" principle be applied when structuring the data base to minimize retrieval time?

(3) Will textual information be coded whenever possible to minimize storage requirements?

(4) Will the results of certain types of analysis (statistical and minor arithmetical manipulation) be fed-back into the data base or will it be calculated when and if needed?

For comparative purposes, if the MAFLA data base is assumed to contain 300, 000 items -- somewhat more than the original estimate -- and that data is stored on magnetic tape, it would only require approximately 132 feet of tape or 5.570 of a standard 2400 foot reel to store the entire file. This assumes standard nine track magnetic tape with 800 byte per inch recording density (8 bits/byte), 32 binary bits per data item, 200 data items per record and O. 5 inch inter recorded gaps. This requirement could almost be divided in half by recording the data on 1600 byte per inch tape -- another industry standard. The MAFLA data base is not considered voluminous. It is structurally complex, however. This consideration affects its use in data base retrieval applications.

Extrapolations of data base sizing, re suiting from the analysis of the SUSIO MAFLA baseline study, to all areas of the OCS mineral management program will be extremely inaccurate. Geographic 10C ation peculiarities of the various OCS areas of interest will introduce other relevant data, different species, and a possible change in some sampling techniques to accommodate the climatic conditions and existing transport systems. The gene ralities that can be drawn from this activity are that the MAFLA sizing study is representative of like-areas where a similar number of stations will be chosen for investigation, replication of samples will remain constant, and similar methods of sampling are feasible. Arbitrary factors could be applied to this sizing to produce rough estimates of the data to be acquired from other environmentally dissimilar OCS areas. This would only allow for a gross (inaccurate) estimate of total OCS data requirements. Nonetheless, if 300, 000 were used as a basis for MAFLA, the mere repetition of that datum to include 17 OCS areas would indicate a total need of 5. 1 million pieces of data. Again, not s ignific ant in relation to the 200 million word capacity of a standard eight-spindle IBM 3330 disk storage device.

The following charts summarize the oceanographic c sampling techniques used in the MAFLA Baseline Study.

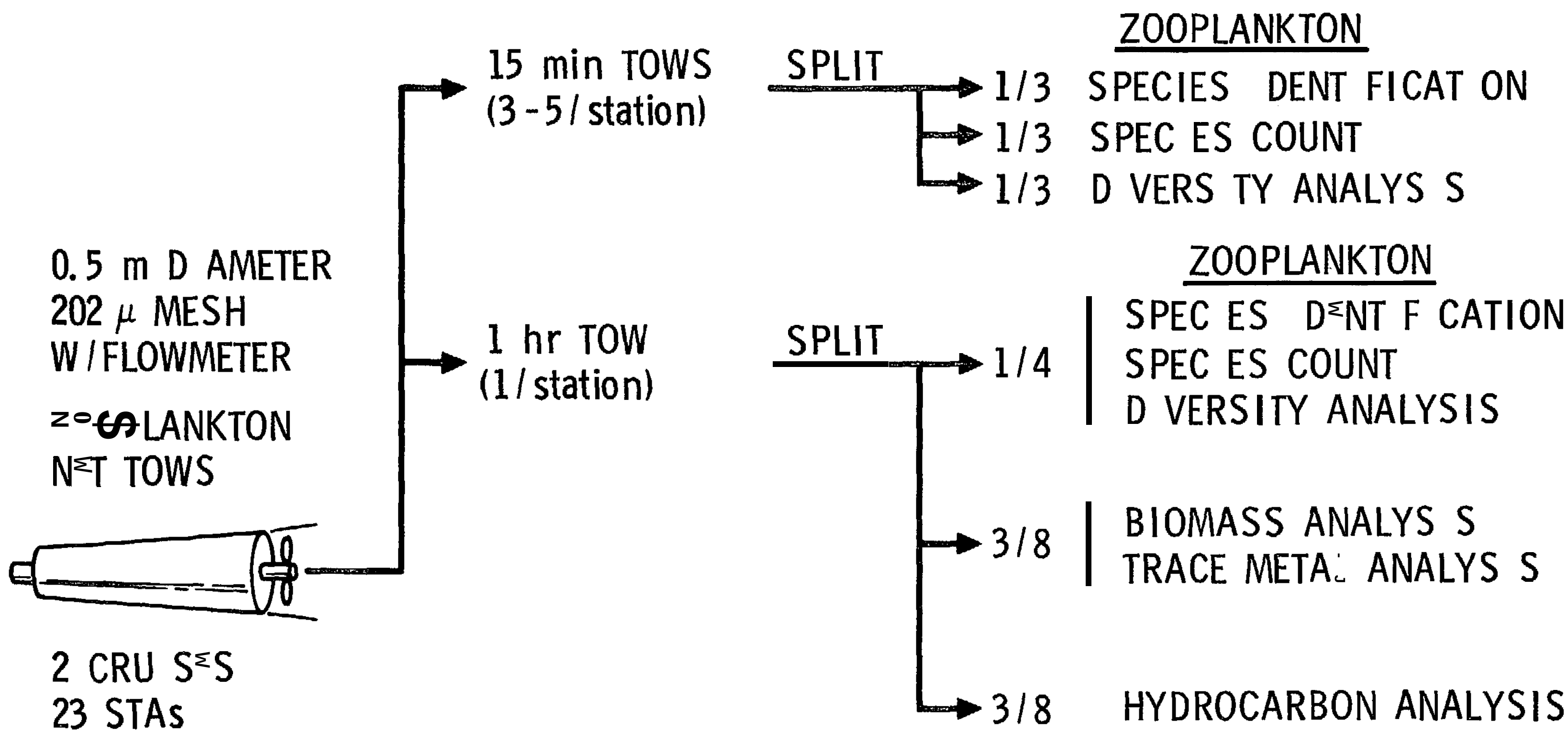


FIGURE 1-2. ZOOPLANKTON TOWS

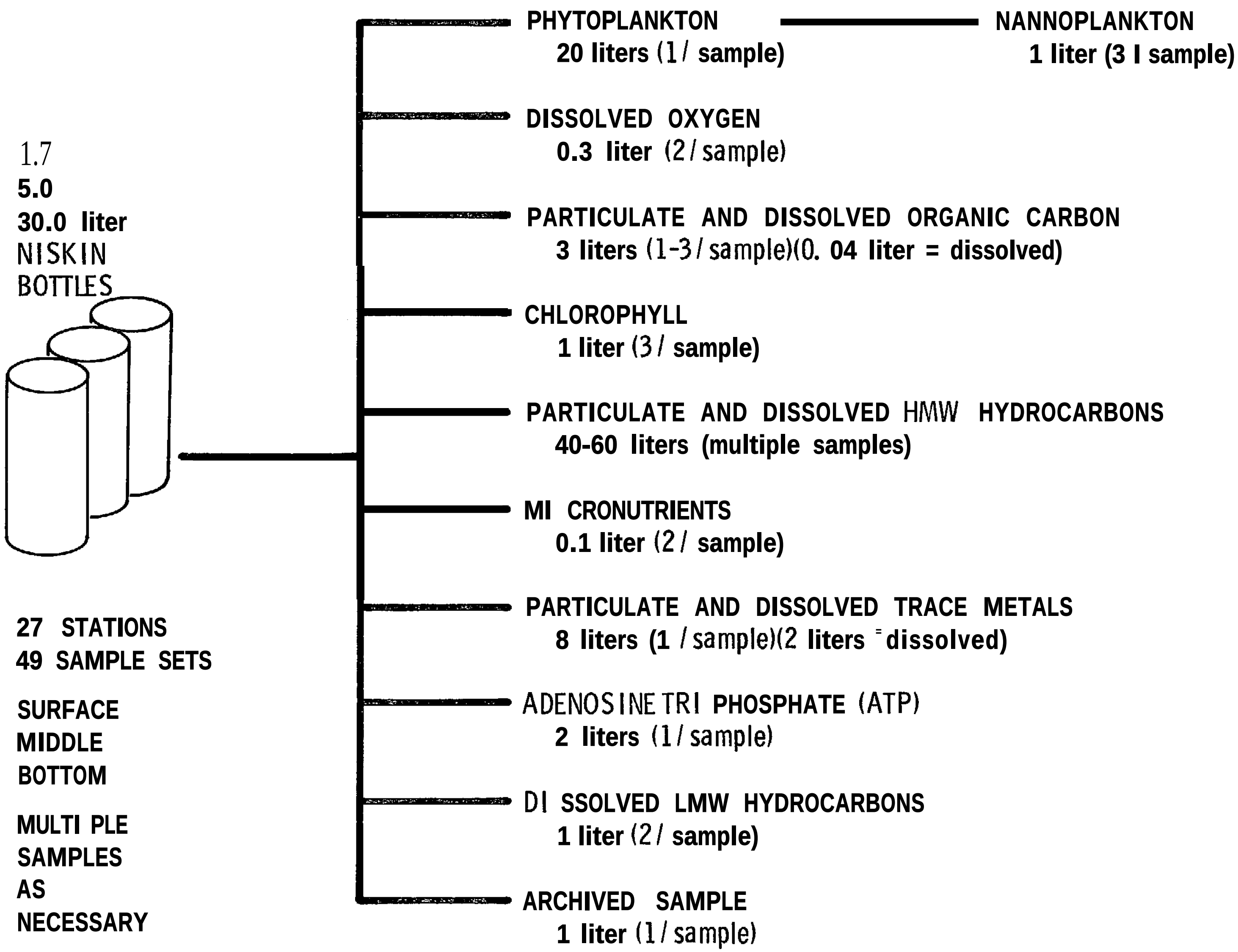


FIGURE 1-3. WATER COLUMN

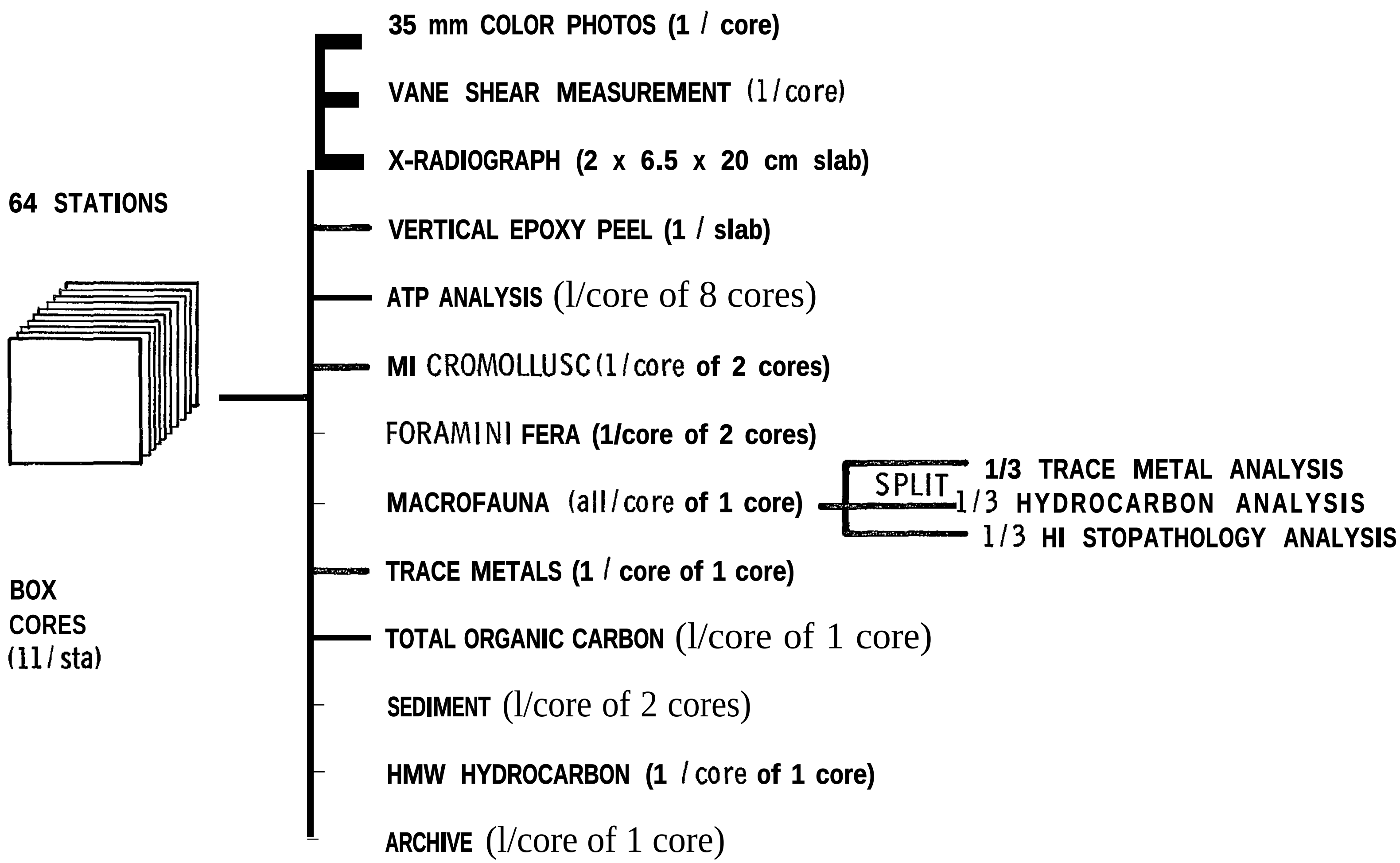
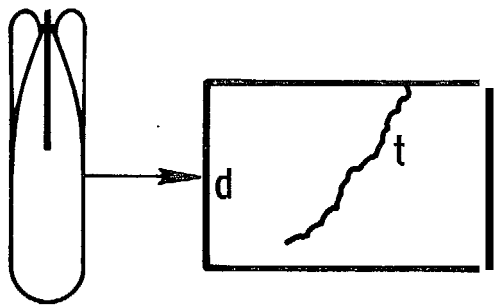


FIGURE 1-4. BOX CORES

EXPENDABLE BATHYTHERMOGRAPH

XBT

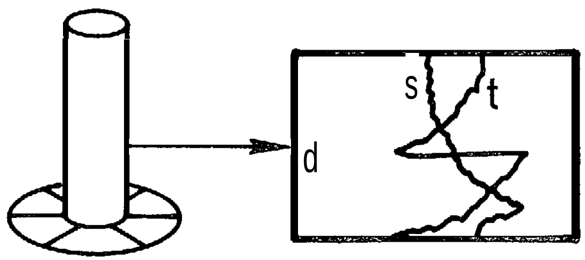


TEMPERATURE AND DEPTH

ANALOG TRACE IS READ
AT 1 fathom INCREMENTS (-200)
OR AT STANDARD DEPTHS (-10-12)

SALINITY-TEMPERATURE-DEPTH **SENSOR**

STD



SALINITY TEMPERATURE AND DEPTH

ANALOG TRACE IS READ
AT 1 fathom 1 NCREMENTS
(-200 rdgs / std)

FIGURE 1-5. EXPENDABLE BATHYTHERMOGRAPH
AND SALINITY-TEMPERATU RE-DEPTH SENSOR

SCUBA DIVES → 35 mm STILL PHOTOS / 8 mm MOVIE PHOTOS → TOPOGRAPH C REL EF

FLORA AND FAUNA HAND COLLECTED

CAPETOWN DREDGE (2/sta) → SH PBOA 2 SORT NG OF BIOTA → DIVERSITY / HYDROCARBON ANALYSIS / TRACE METAL ANALYS S

BOTTOM PHOTOGRAPHY remote) → SUPPORT TO BOX CORING OPERATION → ARCH VED

SNIFFER → DISSOLVED HYDROCARBON
1 R=G/5 m n ASSOC ATED
WITH STA NOS N ALL
5 LEASE AREAS

FIGURE 1-6. MISCELLANEOUS

APPENDIX C

ENVIRONMENTAL DATA SYSTEM SUMMARIES

Extracted from:

> Encyclopedia of Information Systems and Services (Anthony T. Kruzas, ed.) Ann Arbor, Michigan, Edwards Brothers, 1971.

and

> Environmental Science Technology Information Resources (Sidney B. Tuwiner, ed.) Park Ridge, New Jersey, Noyes Data Corporation, 1973.

U. S. BUREAU OF MINES
DIVISION OF FIELD OPERATIONS
ALASKA FIELD OPERATION CENTER
P. O. Box 550
Juneau, Alaska 99801

Telephone: (907) 364-2170

Description of System or Service

The ALASKA FIELD OPERATION CENTER performs engineering exploration of mineral and fuel resources to evaluate the technological, economic, and environmental problems inherent in their development with regard to the unique geographical, geological, climatic, and ecological characteristics of Alaska. The CENTER is comprised of Mineral Deposit Investigations Unit, which conducts field examinations and evaluations of potential mineralized areas; Energy Investigations Unit, which conducts engineering/economic studies evaluating fuel resources and collects data for a geographically- oriented computer data bank; and the Mineral Supply Studies Unit, which conducts engineering evaluations, assesses the effect of technological and economic forces on mineral supply, evaluates mining operations to determine effective mining and processing practices, analyzes consumption patterns, and asses ses the impact of mineral production and consumption on environmental and social problems.

Scope or Subject Coverage

Geology; mining engineering; economics; general science.

Input Sources

Publications of the U. S. Bureau of Mines, the U. S. Geological Survey, other state and federal agencies, and technical presses; data collected in field ope rations.

U. S. BUREAU OF MINES
DIVISION OF FIELD OPERATIONS
EASTERN FIELD OPERATION CENTER
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Telephone: (412) 621-4500

Description of System or Service

The EASTERN FIELD OPERATION CENTER performs engineering and technological investigations to evaluate the availability of mineral resources. It collects, analyzes, and interprets data on technical, economic, and social factors that affect mineral supply or the solution of mineral resource problems. In addition, the CENTER has established a repository for maps of mines located east of the Mississippi River. Maps are microfilmed and indexed for computerized storage and retrieval. The Mine Map Repository will become a basic reference file serving as the principal source of information on mines in the Eastern United States. The CENTER consists of the Energy Group, the River Basin and Repository Group, the Availability Group, and the Nonfuels Group, each of which conducts investigations and appraisals in its particular field.

Scope or Subject Coverage

Mining engineering; geology; fuel resources; mineral resources in areas affected by water development and elsewhere; metallic and nonmetallic resources comprising nonfuels (consumption patterns, end-uses, substitution potentials, impact of production); mine maps (surface and underground).

Input Sources

Data are collected through field investigations; mine maps are acquired from federal, state, and county agencies, mining companies, consulting engineers, and other groups and individuals.

Holdings of Recorded Data

Repository of authoritative maps of current and past mining operations, including data significant to resource and environmental situations, CENTER also maintains a computerized geographically-oriented data bank on energy resources and their social and economic impact.

Microform Services

Microreproduction; maps are stored as 35mm microfilm rolls and aperture cards.

U.S. BUREAU OF MINES
DIVISION OF FIELD OPERATIONS
INTERMOUNTAIN FIELD OPERATION CENTER
Building 20, Denver Federal Center
Denver, Colorado 80225

Telephone: (303) 233-3611 x 6521

Description of System or Service

The IN TERMOUNTAIN FIELD OPERATION CENTER performs engineering and technological investigations to evaluate the availability of mineral resources. It also collects, analyzes, and interprets data on technical, economic, and social factors that affect mineral supply or the solution of mineral resources problems. Supporting services for the CENTER consist of diverse projects requiring the maintenance of a force of people engaged in a wide range of activities throughout the area encompassed by the C-ENTER (other INTERMOUNTAIN operations are in Minnea-polis /St." Paul, Minnesota, and Dallas, Texas).

Scope or Subject Coverage

Environmental and engineering studies, including mineral supply, energy, and environment; wilderness; river basin.

Input Sources

Data collected through field operations, maps, and other relevant documents.

Holdings of Recorded Data

The Environmental Unit of Environmental and Engineering Studies has established a repository of authoritative maps that show data on past and cur rent mining operations, with emphasis on maps of mines where adverse impacts to the environment are most severe; the Energy Unit collects data for a geographically-oriented computer data bank on fuel resources. In addition, the Library maintains a collection of 15, 000 volumes on mineral resources, mining engineering, geology, statistics of mining production, and economics of mining.

U. S. BUREAU OF MINES
DIVISION OF FIELD OPERATIONS
WESTERN FIELD OPERATION CENTER
West 222 Mission Avenue
Spokane, Washington 99201

Sponsoring Organization

U. S. Department of the Interior (parent agency).

Description of System or Service

The WESTERN FIELD OPERATION CENTER performs engineering and technological investigations to evaluate the availability of mineral resources. It collects, analyzes, and interprets data on technical, economic, and social factors that affect mineral supply or the solution of mineral resource problems. The CENTER consists of: Wilderness and Mineral Deposit Investigations, Mineral Supply Studies, and River Basin, Mineral Involvement, and Solid Waste. Each group conducts evaluations, appraises developments, and as ses ses impacts of mineral consumption affecting particular subjects with which the group is concerned.

Scope or Subject Coverage

Mining engineering; wilderness areas; mineral supply and operations as affected by technologic and economic forces; mineral resources as affected by water supply; geology.

Input Sources

Data collected in field investigations.

Holdings of Recorded Data

No information available.

U.S. BUREAU OF MINES
MINERAL SUPPLY
18th and C Streets, North West
Washington, D. C. 20240

Telephone: (202) 343-2193

Description of System or Service

MINERAL SUPPLY collects, analyzes, and disseminates information for use by government and industry concerning worldwide supply and demand for minerals and fossil fuels. It also administers programs to achieve this miss ion and participated in formulating U. S. Bureau of Mines policy related to mineral resources. MINERAL SUPPLY'S specific concern is directed to the means by which the current and emerging demands for minerals and fuels may be met, the real cost of such achievements, and the assessment of related socio-economic factors. It seeks ways to accommodate the evolving material needs of America's highly industrialized society without sac rif ice of environmental values.

Scope or Subject Coverage

All aspects of mineral and fuel production, including consumption, reserves, mining and mineral processing technology, and mineral economics.

Input Sources

Statistical data are acquired by canvassing mineral, metal, and mineral fuel producers and consumers on questions related to production, consumption, and sales; internal studies and field investigations, as well as technical and trade journals in the mining/mineral field, are additional input sources.

Holdings of Recorded Data

MINERAL SUPPLY maintains a permanent record of statistical data collected, as well as all U. S. Bureau of Mines' publications and a number of volumes on metallurgy, mineral economics, statistics, mining and related subjects.

Microform Services

Microreproduction; mine maps are maintained in microform.

Computer and Information Proces sing Equipment

MINERAL SUPPLY uses a Honeywell 1250 computer and a Burroughs 5500 computer to process statistical data; languages used are COBOL and BESTOP.

U.S. ENVIRONMENTAL PROTECTION AGENCY
AIR POLLUTION CONTROL OFFICE (APCO)
NATIONAL AEROMETRIC DATA BANK (NADB)
5725 Dragon Way
Cincinnati, " Ohio 45227

Telephone: (513) 272-0608

Des cription of System or Service

The NATIONAL AEROMETRIC DATA BANK (NADB) was established in 1969 to maintain a central repository of all aerometric data by means of the computerized SAROAD (Storage and Retrieval of Aerometric Data) System. SAROAD handles the flow of data into and out of the BANK including data preparation, validation, updating, processing, and retrieval operations, while the BANK consists of the data and set of physical files where they are stored. Data are converted to the SAROAD format where necessary and routinely updated through the SAROAD System. Output is in the form of summaries, listings, punched cards, or magnetic tapes. Contributing agencies receive these summarized data listings as an aid in interpretation. DATA BANK also prepares graphs of possible trends and displays of statistical investigations.

Scope or Subject Coverage

Air quality and meteorological data primarily; emissions inventor y and health and economics effects data will be added at a later date.

Input Sources

Data representing a consecutive 3 -month period with sampling interval of 1 hour or greater from a representative site, validated and in the same metric units as NAPCA's aerometric data to permit interpretation on a nationwide basis; monitoring is done and submitted by various state, local, and federal agencies whose data must fit the above criteria.

Holdings of Recorded Data

Samplings of approximately 500 sites are now incorporated into the BANK, with current input of 118, 000, 000 characters annually and expansion to over 1, 000, 000, 000 annually by 1975.

Magnetic Tape Services

Data are available in magnetic tape format on request.

Continued . . . . . .

Continued . . . . . .

Computer and Information Processing Equipment

System is currently operational on a Honeywell 400 in Assembly language and FORTRAN, and on an IBM 1130 in Assembly language and FORTRAN. System is being redesigned to an IBM 360/50 with 512K words or core, operated under OS, MVT, using FORTRAN, COBOL, Mark IV, a proprietary software package; an RFP is being prepared for a larger computer.

User Restrictions

Services are available without restrictions to contributing agencies; requests from other federal agencies, universities, and various private institutions are honored as resources permit.

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND MONITORING
401 M Street, South West
Washington, D. C. 20460

Telephone: (202) 755-2673

Description of System or Service

STORET: The central computer -oriented segment of EPA's National Water Quality Surveillance and Information System for storing and retrieving data and information on water quality; water quality standards, pollution caused fish kills; manpower and training needs; municipal and industrial waste discharges; and waste abatement needs, costs and implementation schedules. Forty-two federal terminals throughout the country for on-line access to STORET performs the function of a filing and classifying system and a data statistical analysis and evaluation system.

TOXIC ON: A generalized on-line storage and retrieval system. Accepts abstracts and data (EPA's pesticide community studies) coming from the various contributing programs in a standardized format. (Access by remote terminals to the public).

ENVIRON: EPA Office of Research and Monitoring's information system. An on-line interactive retrieval system, ENVIRON is oriented towards information retrieval problems which are characterized by difficult and vague subject definition, extensive variance in term selection, changing scientific and technical terminology, and imprecise search definition. Reference library oriented.

Input Sources

Federal and State agencies.

Computer and Proces sing Equipment

Systems use an IBM 370/ 155 under standard OS/TSO interface.

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
NATIONAL WATER DATA SYSTEM (NWDS)
18th and F Streets, North West
Washington, D. C. 20242

Telephone: (202) 343-9425

Sponsoring Organization

U. S. Department of the Interior (parent agency).

Description of System or Service

The NATIONAL WATER DATA SYSTEM (NWDS) was established to measure and quantify the occurrence and quality of the United States' water resources and the effect of development and utilization on those resources. NWDS makes statistical data and summary reports on water data available to planners, developers, and managers. Although NWDS is still in the developmental stage, data on sites at which repetitive measurements of water quality and quantity have been made is stored in the Catalog of Information on Water Data. Users of this catalog can determine data availability and request data from the appropriate source listed. Presently included in the activities of the Water Resources Division is the coordination of certain water data acquisition programs by federal agencies; ultimately, NWDS will identify and make accessible to all users all water data acquired in the United States by both government and private interests.

Scope or Subject Coverage

Surface water stage and discharge; chemical quality parameters; radiochemical sediment; pesticide and certain biological concentrations in water; ground and surface water levels; geologic data describing the framework in which ground water occurs; flood frequent y and flood inundation mapping.

Input Sources

Data as measurements and observations collected by U. S. Geological Survey, states, counties, and local interest groups.

Holdings of Recorded Data

Observations from 9, 000 streamflow gauging stations, 4, 000 water quality measuring stations, and 30, 000 observation wells for recording changes in ground-water storage - all operated by the U. S. Geological Survey. Files contain historical data dating to about 1890 in addition to current data.

Continued . . . . . .

Continued . . . . . .

Magnetic Tape Services

Data from publications are available on magnetic tape or cards; 9-channel 800 BPI tapes can be supplied on request; data are retrieved by a unique station number latitude-longitude> state, county, river basins, data type, and date.

Other Services

Card services; data collection and analysis; reference service.

Computer and Information Processing Equipment

NWDS uses IBM 360/65, 360/30, and three IBM 360/20 computers with 7-track tape units, 9-track tape units, 2314 disc packs, card reader/punches, printers, Barrington Page Reader model 3030, and Calcomp pen plotter, model 763; the operating system is OS for the 36o with HASPII: most programs are written in PL/1 programming languages.

User Restrictions

Services are available without restrictions; users are required to pay the computer costs involved in the selection and duplication of data.

U. S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE (EDS)
8060 13th Street, Gramax Building
Silver Spring, Maryland 20910

Telephone: (301) 495-2412

Sponsoring Organization

U. S. Department of Commerce (parent agency).

Description of Svstem or Service

The ENVIRONMENTAL DATA SERVICE (EDS) combines the former Environmental Science Services Administration's Environmental Data Service and the National Oceanographic Data Center. It acquires, processes, and disseminates environmental data collected by government agencies and private institutions, and develops improved methods for processing and presentation. EDS operates the national data centers for geodetic, geomagnetic, seismological, meteorological, aeronomic, and oceanographic data, and under an agreement with the National Academy of Sciences, EDS provides administrative support for the corresponding World Data Centers A, which receive data from cooperative investigations and other international sources. EDS answers inquiries; evaluates and interprets data; publishes and distributes bibliographies, periodicals, data compilations, and technical reports in synoptic, graphic, narrative, and tabular form. Besides its publications, EDS makes available microfilm, punched cards, magnetic tapes, radar and satellite film, original records or duplicate copies, autographic traces, and film chips.

Scope or Subject Coverage

Individual data centers cover: climatology; oceanography; meteorology (including satellites); hydrology; seismology; geomagnetism; aeronomy and space (upper atmosphere, ionosphere, airglow, cosmic rays, auroras, solar activity), tsunami, and geodesy.

Input Sources

Data collected by government agencies and by private institutions, as well as published literature.

Continued . . . . . .

Continued . . . . . .

Holdings of Recorded Data

Collection includes all weather records routinely collected by the federal government, as well as large quantities of data acquired from foreign sources and from cooperative exchanges with state or local agencies; a national depository of unclassified oceanographic data; geodetic control data established by various governmental agencies and commercial firms; seismograms recorded since 1963 by a standardized global network of 114 stations, plus those from a 25 -station Canadian network; the largest collection of international geomagnetic data (magneto grams) in the world; aeronomy and space data from observatories around the world; seismological and tide data from an international tsunami warning network.

Microform Services

Services vary with discipline involved; contact appropriate data center for further information.

Magnetic Tape Services

Services vary with discipline involved; contact appropriate data center for fur the r information.

Other Services

Card services; consulting; cooperative programs; copying; data collection and analysis; depository; interlibrary loan; literature searching; reference and referral services; research; state-of-the-art compilation.

Computer and Information Proces sing Equipment

Different computer systems are used in various data centers; FORTRAN and COBOL are the basic programming languages used.

User Equipment Requirements

Equipment needed depends on the data form requested by user; most data centers provide multiform data.

User Restrictions

Services available to all without restrictions.

U.S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE (EDS)
NATIONAL CLIMATIC CENTER (NCC)
6001 Executive Boulevard
Rockville, Maryland 20852

Telephone: (301) 496-2131

Sponsoring Organization

U. S. Department of Commerce (parent agency). National Oceanic and Atmospheric Administration, Environmental Data Service.

Description of System or Service

The NATIONAL CLIMATIC CENTER (NCC) collects, evaluates, publishes, and distributes climatological data routines. It archives and microfilms the basic records and retrieves them as needed. The NCC is the collection center and custodian of all United States weather records and is the largest data center in the Environmental Data Service. The World Data C enter A for Meteorology and Nuclear Radiation is housed with the NCC at Asheville, North Carolina. NCC also helps users solve specific climatological problems by furnishing data in the particular form and quantity need, preparing special tabulations or summaries on request, and providing referrals to private meteorological consultants for those who require assistance in interpreting the information supplied.

Scope or Subject Coverage

Global (surface to 500, 000 feet) meteorological elements including clouds, temperature, humidity, pressure, visibility, wind direction, wind speed, precipitation, and solar radiation.

Input Sources

A wide variety of documents, each containing selected meteorological measurements.

Holdings of Recorded Data

Collection includes 73, 900 foreign data and reference volumes held as records, charts, maps, microfilm, punched cards, and magnetic tape; 98 periodical titles and 500 serials from 90 countries are received.

Continued . . . . . .

Continued . . . . . .

Microform Services

Holdings include over 70,000 reels of film containing weather records, maps, radar scope pictures and satellite photography on 35mm reels, 16mm reels, and 70mm reels, 5-inch reels, film strips, and microfiche form. Copies are available at cost.

Magnetic Tape Services

Copies of available meteorological data on magnetic tape can be furnished at cost on either 7 or 9 channel tape. Recording characteristics of 7 channel tape: density either of 200/556/800 CPI, even parity, Binary Coded Decimal (BDC) mode; recording characteristics of 9 channel tape: density 800 BPI and EBCDIC mode.

Other Services

Cooperative program; copying; data collection and analysis; depository; reference and referral services; state-of-the-art compilation.

Computer and Information Processing Equipment

NCC uses dual RCA Spectra 70/45-1 computers with a full range of peripheral devices; the programming languages used are COBOL and FORTRAN IV.

User Restrictions

Services are available on a cost basis to individuals or organizations from the governmental, commercial, and scientific communities.

Remarks

The World Data Center A - Meteorology and Nuclear Radiation is housed within the NCC. All data contained in World Data Center A are not housed in, available to, and a part of the archives of the NCC. No permanent staff accompanies the World Data Center A, but NCC employees answer requests directed to WDC -A, as needed. All data sources and services in NCC entry are available to WDC-A.

U. S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE (EDS)
NATIONAL GEOPHYSICAL AND SOLAR -TERRESTRIAL
DATA CENTER (NGSDC)
30th and Marine Street
Boulder, Colorado 80302

Telephone: (303) 499-1000

Sponsoring Organization

U. S. Department of Commerce (parent agency).

Description of System or Service

The NATIONAL GEOPHYSICAL AND SOLAR TERRESTRIAL DATA CENTER (NGSDC) acquires, analyzes, and publishes geophysical and solar-terrestrial data. It attempts to meet user requirements and to provide the user with ready access to needed information. In addition, it provides operation for a World Data Centers A in its subject fields.

Scope or Subject Coverage

Geomagnetism; seismology; gravity; aeronomy; space; related geo-physical data from land, marine, and airborne platforms.

Input Sources

Geophysical and solar-terrestrial physics, observations and data from ships, observatories, and other data generators on a world-wide basis.

Holdings of Recorded Data

Holdings consist of charts and records, seismographs, magnetographs, and ionograms; also marine geophysical data from ships (seismic, gravimetric, magnetic, and bathymetric).

Microform Services

Copies of data in 35mm and 70mm form are available at cost of reproduction.

Magnetic Tape Services

Tapes containing data tabulations are available at cost of reproduction.

Continued . . . . .

Other Services

Data collection and analysis; depository; reference and referral services.

Computer and Information Processing Equipment

NGSDC utilizes an IBM 360/65 computer; programming languages used are COBOL, PL/ 1, and FORTRAN.

User Equipment Requirements

None. NGSDC generally provides the user with data in formats compatible with needs.

User Restrictions

Services available without restrictions.

Remarks

The NATIONAL GEOPHYSICAL AND SOLAR- TERRESTRIAL DATA CENTER facility in Boulder was created from the former Aeronomy and Space Data Center, which had been in Boulder since 1957, and the National Geophysical Data Center which began moving west from Was hington, D. C. in 1971. All elements are now located in Boulder except for the Marine Geology and Geophysics Group in Washington, D. C. , and a data-copying facility in Ashville, N. C.

U.S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINIST RATION
NATIONAL OCEAN SURVEY
LAKE SURVEY CENTER
GREAT LAKES PHYSICAL INFORMATION ANALYSIS CENTER (G LPIAC)
635 Federal Building and U. S. Courthouse
Detroit, Michigan 48226

Telephone: (313) 226-6126

Sponsoring Organization

U. S. Department of Commerce (parent agency).

Description of System or Service

The GREAT LAKES PHYSICAL INFORMATION ANALYSIS CENTER (GLPIAC) is concerned with the selective acquisition, technical review and analysis, storage and retrieval, and dissemination of information concerning the Great Lakes.

Scope or Subject Coverage

The Great Lakes Basin Area, including hydrographic surveys, charts and cartography, water levels (regulation), motion and river flow, water characteristics, and hydrology (ice cover and shore processes).

Input Sources

Field observations, survey drawing, aerial photographs, notebooks, computations, soundings, analog records, and published literature.

Holdings of Recorded Data

Hydrometeorological data includes over 3, 000, 000 observations; limnological data includes over 1, 000, 000 observations; technical data includes over 1, 000, 000 observations; over 10, 000 volumes of technical reports, scientific manuscripts, studies, summaries and reprints are maintained, as well as over 20, 000 field notebooks and observations. Subjects included are: hydrography, hydraulics, hydrology, limnology, information analysis, oceanography (physical, chemical, and biological), ocean/coastal engineering and geology, navigation, meteorology, water quality control, recreation, urban planning, environmental preservation and enhancement, operations research and mathematics.

Continued . . . . . .

Continued . . . . . .

Microform Services

Micro reproduction.

Magnetic Tape Services

None.

Computer and Information Proces sing Equipment

Xerox Data Systems, XDS 700.

U.S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINIST RATION
NATIONAL OCEAN SURVEY
OFFICE OF HYDROGRAPHY AND OCEANOGRAPHY
MARINE INFORMATION BRANCH
6001 Executive Boulevard, Building 1, C352
Rockville, Maryland 20852

Telephone: (301) 496-8408

Sponsoring Agency

U.S. Department of Commerce (parent agency).

Description of System or Service

The MARINE INFORMATION BRANCH supports the entire U. S. National Oceanic and Atmospheric Administration fleet in acquiring data, both hydrographic and geophysical, with applications in the development of nautical charts and geophysical, with applications in the development of nautical charts and geophysical mapping. The National Ocean Survey, combining the activities of the former Coast and Geodetic Survey and the U. S. Lake Survey, prepares nautical and aeronautical charts; conducts precise geodetic, oceanographic, and marine geophysical surveys; monitors the earth's geophysical fields and seismic activity; predicts tides and currents; and issues tsunami warnings to the Pacific Ocean area. It also prepares and publishes navigational charts and related materials for the Great Lakes, and conducts investigations of the physical aspects of the lake waters.

Scope or Subject Coverage

Hydrographic and geophysical data concerning the coastal areas of the fifty United States, Puerto Rico, the Virgin Islands, the Canal Zone, and the Great Lakes; some tracklines and geophysical measurements are on a global basis.

Input Sources

Data from vessels and field parties submitted as log and analog records, paper and magnetic tape, punch cards and print-outs, descriptive reports.

Holdings of Recorded Data

Collection consists of more than 23, 000 survey sheets and related documents, both hydrographic and topographic, 90, 000 units of geophysical data from 1957 to date; Office of Hydrography and Oceanography maintains a file of all acquired Coast and Geodetic Survey data.

Continued . . . . . .

Continued ......

Microform Services

Microfilming is used for essential records, programs, and security storage; other microform services are available for disseminating data copies to non-government users.

Magnetic Tape Services

Some data is received in the form of magnetic tape or punch cards for internal applications.

User Restrictions

Services available to all without restrictions.

U.S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINIST RATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER (NMC)
Washington, D. C. 20233

Telephone: (301) 440-7156

Sponsoring Agency

U. S. Department of Commerce (parent agency).

Des criotion of Svstem or Service

The NATIONAL METEOROLOGICAL CENTER (NMC) collects worldwide data on a continuous basis, processes the data, using both manual and computer techniques, into meteorological analyses, and produces weather predictions. It warns the public of tornadoes, hurricanes, floods, and other atmospheric and hydrologic hazards, and provides a broad array of special services to aeronautical, maritime, astronautic, agricultural, and other weather- sensitive activities. Its services are supported by a national network of observing and of recasting stations, communications links, aircraft, satellite systems, and computers. Some 300 National Weather Service offices across the country ensure prompt and useful dissemination of weather information.

Scope or Subject Coverage

Weather predictions and meteorological phenomena.

Input Sources

Weather observations from around the world on a routine schedule are transmitted on teletype circuits in a numerically coded format.

Holdings of Recorded Data

The CENTER maintains a 60-day file of all analyses and forecasts in either graphical or magnetic tape format; it also has a small collection on various topics related to meteorology.

Magnetic Tape Services

See above under Description of System or Service.

Continued . . . . . .

Continued . . . . . .

Computer and Information Processing Equipment

NMC utilizes two IBM 360/40 computers (one as a communications control system and the other as back-up), with IBM 7094-11, 1301 disc file, 729 tape units, a card reader/printer, 2841 controller, disc drives, tape drives, reader-punch, printer, plus 2703, 2702, 2701 communication controllers, all interconnected between both CPU's. IBSYS is used with FORTRAN and machine language. Communications Control Applications Program (CCAP) is used under DOS with FORTRAN and COBAL; NMC has utilized an IBM 360/30, 2841 controller, disc drives, tape drives, plus specialized graphics equipment for high-speed graphical display and automatic generation of charts and digital information. IBM 1401 is used for input/output.

User Restrictions

Services are available to all without restrictions.

UNIVERSITY OF CALIFORNIA, SAN DIEGO
SCRIPPS INSTITUTE OF OCEANOGRAPHY
BATHYTHERMOGRAPH (BT) DATA PROCESSING AND ANALYSIS FACILITY
8602 La Jolla Shores Drive
P. o. Box 109
La Jolla, California 92037

Telephone: (714) 453-2000 x1135

Sponsoring Organizations

U. S. Office of Naval Research, U. S. Naval Oceanographic Office, and the U. S. National Oceanographic Data Center.

Description of System or Service

The BATH YTHERMOGRAPH (BT) DATA PROCESSING AND ANALYSIS FACILITY processes and archives BT temperature data of the Pacific and Indian Oceans, surface temperature observations collected at shore stations on the west coast of North America, and tide records for the Scripps Pier at La Jolla, California. The FACILITY also archives published hydrographic station data, such as temperature, salinity, and chemical determinations for the Pacific Ocean.

Scope or Subject Coverage

Oceanic res earth including temperature, salinity, and tidal data.

Input Sources

Bathythermograph slides, published hydrocast data, summaries of proces sed bathythermograph and hydrocast data on magnetic tape, or tape listings.

Holdings of Recorded Data

Holdings consist of 650, 000 bathythermographs of temperature data of the Pacific and Indian Oceans, from 1941 to date; 400, 000 surface temperature observations from shore stations on the west coast of North America, from 1916 to date; tide records for Scripps Pier, from 1924 to date; and 50, 000 hydrographic station data, such as temperature, salinity and chemical determinations for the Pacific Ocean. FACILITY has access to collections of Scripps Institute of Oceanography.

User Restrictions

Data are made available to federal and state government agencies and to oceanography departments or laboratories of educational and research ins titutions.

WORLD 13ATA CENTER -A
COORDINATION OFFICE
National Academy of Sciences
2101 Constitution Avenue, North West
Washington, D. C. 20418

Telephone: (202) 961-1404

Sponsoring Organization

Operated under the auspices of the U. S. National Academy of Sciences.

Description of System or Service

The WORLD DATA CENTER - A, consisting of a Coordination Office and eight subcenters, was established in the United States in accordance with the principles set forth by the International Council of Scientific Unions as part of a fundamental international plan to collect data from numerous and wide-spread observation posts and to exchange these data and make them available to the scientific communities of all countries involved. Each WORLD DATA CENTER - A collects a complete set of data in its respective field; maintains these incoming data; reproduces it, maintaining adequate standards of clarity and durability; supplies copies to other WDC's of data which they do not receive; prepares catalogs of all data in its charge; and makes data available to the scientific community. In addition WDC - A is responsible for compiling materials into reports or pamphlets to more conveniently serve research interests; encouraging research by loaning materials; especially when additional copies exist; and using their good offices in securing data for scientists even though the data centers do not have them.

Scope or Subject Coverage

Geomagnetism, seismology, and gravity; glaciology; longitude and latitude; meteorology and nuclear radiation; oceanography; rockets and satellites; solar and inter-planetary phenomena, ionospheric phenomena, flare-associated events, aurora, cosmic rays, airglow; tsunamis.

Input Sources

Original (raw) and calibrated (reduced or analyzed) data, depending on subject involved.

Holdings of Recorded Data

Variable, depending on discipline and resources available where WDC - A is located.

WORW DATA CENTER A - OCEANOGRAPHY
Second and NStreets, South East, Building 160
Washington, D. C. 20390

Telephone: (202) 693-3753

Sponsoring Organizations

U.S. National Science Foundation is the funding agency and U.S. National Oceanic and Atmospheric Administration, National Oceanographic Data Center (NODC) administers World Data Center A - Oceanography.

Description of System or Service

WORLD DATA CENTER A - OCEANOGRAPHY is collocated with and administered by the National Oceanographic Data Center. It conducts international exchange of oceanographic data and publications, in addition to collecting, cataloging (but not processing) and archiving data. WDC-A-OCEANOGRAPHY acquires oceanic data for declared national programs, international cooperative expenditions, and other oceanographic programs.

Scope or Subject Coverage

Physical and chemical oceanographic data of these major types: serial station; bathythermographic; current; bottom topographic; bottom composition; biological; meteorological; sea surface.

Input Sources

Data obtained from various stations and expeditions are submitted in diverse formats.

Holdings of Recorded Data

CENTER's international marine data base includes over 250, 000 serial oceanographic station records, in addition to reports which have been machine-processed by NODC and are in punched card or tape form. Special collections include oceanographic data from the International Geo - physical Year and the International Indian Ocean Expedition; a collection of 1, 000 volumes, oceanographic data on log sheets and machine listings for more than 60, 000 stations.

Magnetic Tape Services

Some holdings are in tape form and can b-e reproduced on demand.

Computer and Information Processing Equipment

National Oceanographic Data Center provides machine data processing support.

APPENDIX D

OCEANOGRAPHIC AND WATER QUALITY DATA SYSTEMS

EDMPAS	-- Gulf Universities Research Consortium
NODC	-- National Oceanographic Data Center
STORET	-- Environmental Protection Agency
UBSDB	-- Westinghouse e Oceanic Research Laboratory

1.0 EDMPAS (GULF UNIVERSITIES RESEARCH CONSORTIUM)

The Gulf Universities Research Consortium (GURC) is a non-profit corporation located in Galveston, Texas. Participants in the Consortium include over twenty universities and various non-profit research institutes. GUR C manages multi-disciplined, multi-institutional research programs from the planning stage through implementation. Its attention has been primarily focused on research programs relating to the ecology and environment of the Gulf of Mexico region. However, as a direct result of the development of a computerized data management system, the scope of GURC programs has broadened beyond marine sciences into fields such as agriculture, medicine and demographics.

1.1 The EDMPAS System

The Environmental Dependent Management Process Analyses and Simulation (EDMPAS) system, shown in Figure 1-1, is a user problem-oriented system capable of handling biological, physical, geological, chemical, economic and legal data. According to GURC, the system allows disparate, discipline-oriented data bases resulting from environmental field operations to be consolidated for interdisciplinary synthesis leading to interpretation of dynamic ecosystem behavior and impact patterns.

The EDMPAS system is a family of modularly interfaced program packages (modules) in which each self-contained module is designed to accomplish a specific task. A sequential application of a selected combination of modules will accomplish the data processing function desired by the user scientists. The system features the following capabilities: complete file addressibility, unlimited Boolean query, virtually unlimited descriptors, free-field data entry, dictionaries built automatically from input data, data file compression of binary sort on compressed data, and sequential data access. The Environmental Information Retrieval (ENVIR) system, coded in FORTRAN V, is the primary module of the EDMPAS system. ENVIR is responsible for file merging and structuring, the direct access of any bit within a file, correction, update and selective retrieval functions.

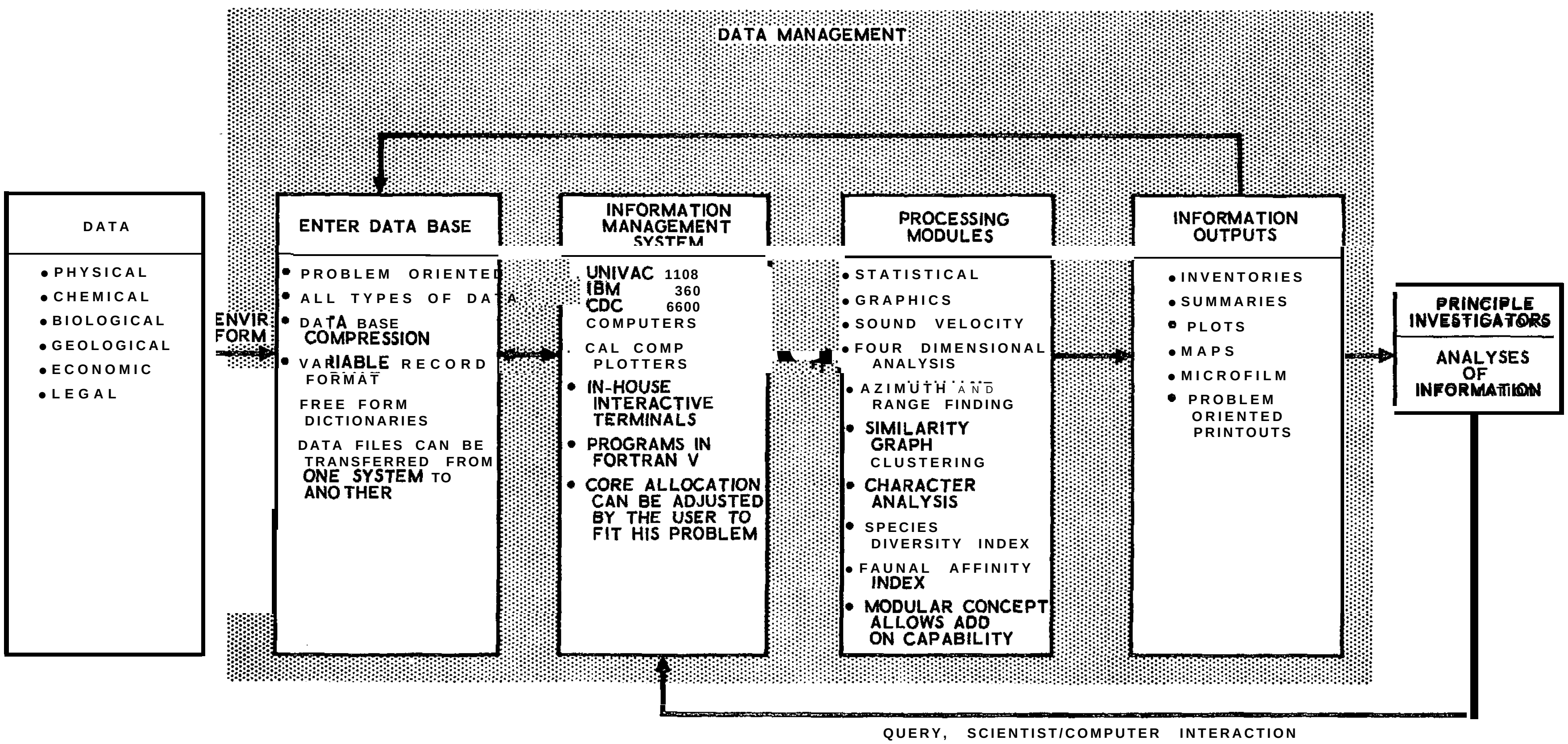


FIGURE 1-1. GULF UNIVERSITIES RESEARCH CONSORTIUM DATA CENTER (PROBLEM ORIENTED SYSTEM)

1.2 Use of the System

For each specific research project, the principal scientist must determine the items (records) and descriptors (parameters) for the data which will comprise the data bank. (See Figure 1-2). Each parameter is assigned a name and sequenced in the desired order within a record. There are three descriptor options offered to the user: des c ription by alphanumeric name (f SPECIES'), by numeric code (1, 2, . . . , N), or by order (JANUARY TO DECEMBER, 0° to 90°, etc.).

After the descriptor list (Figure 1 -3) is constructed and trans - " lated to machine readable form, the scientist has described the data bank. The actual data is acquired, analyzed and recorded in field or lab note-books containing data sheets, such as those shown in Figure 1-4. The data is then transferred to a coding sheet (Figure 1-5) for keypunching or is keypunched directly from the notebook.

After verification by the keypunch operator, a card image magnetic tape is created for input to ENVIR. At that time, the user has the option to allocate computer core based on knowledge of the data characteristics and expected transactions, This is accomplished by changing array dimensions in the ENVIR driver program and recompiling.

The descriptor and the BCD data bank are then input to ENVIR to create a compressed binary data file and a dictionary (Figure 1-6). The data file can then be updated by adding more items or descriptors, by deleting items, or by correcting errors detected in compilation. The data file can also be queried using Boolean logic in English language for selective retrieval of a subset of the file.

For sorting or retrieval in response to a query, ENVIR scans the entire data file in core at core speeds in blocks or buffer loads. Because the data is stored in a highly compressed state, the CPU time is less than it would be for manipulating uncompressed data. Special computation interfaces allow the user to input the subset binary file into a variety of application processing programs listed in Table 1-1. Because of the modular structure of the system, new processing programs can be added with minimal effort.

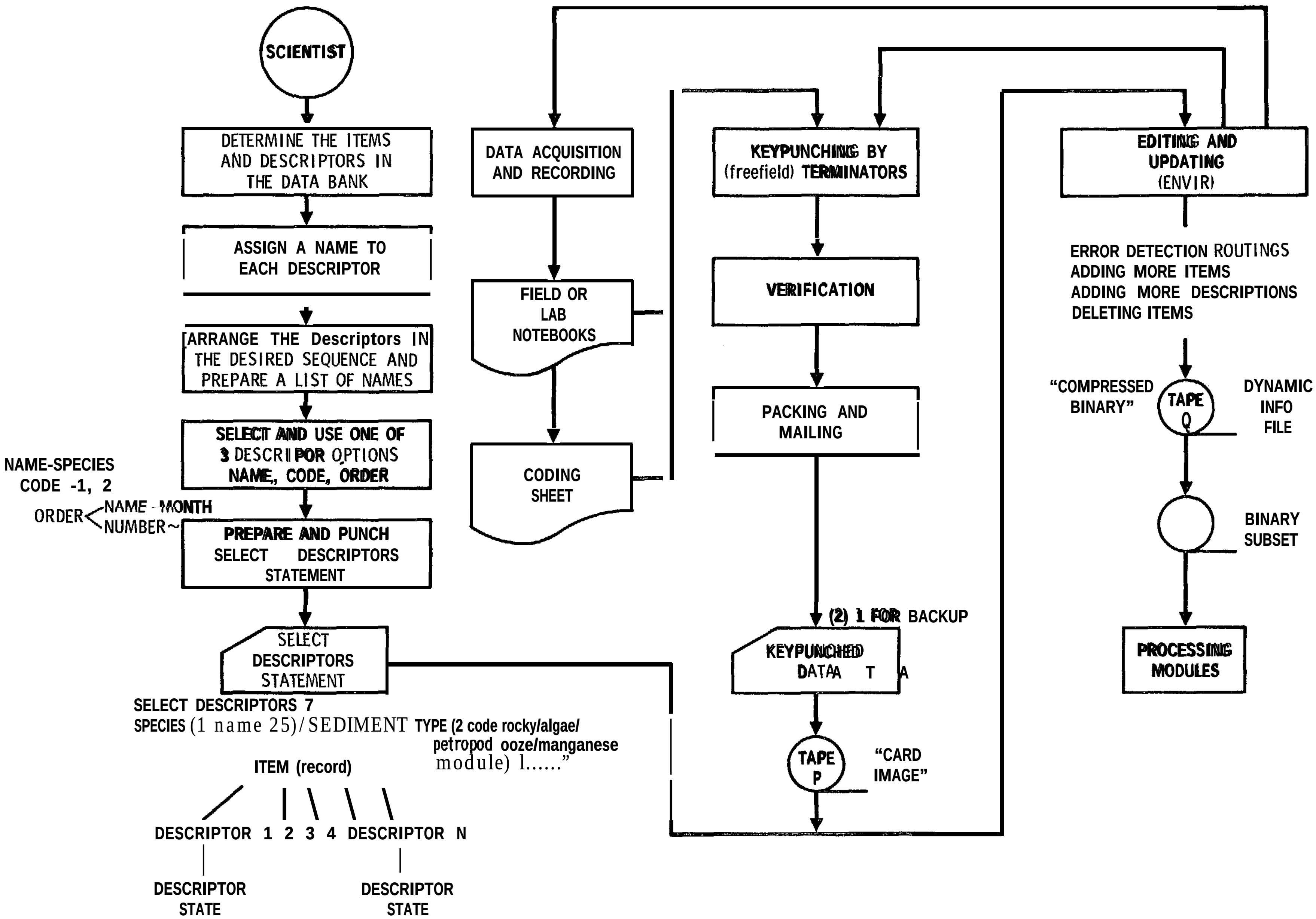


FIGURE 1-2. GURC PREPROCESSING

JAMES P. MAR UM
ZOOPLANKTON DATA STORAGE
OFFSHORE ECOLOGY INVESTIGATION
DESCRIPTION LIST -BANK NO. ONE

	DESCRIPTOR	TYPE	EXAMPLE
1.	Cumulative sample no.	From-To	e.g. 0243 (4 digit no.)
2.	OEI	"	e.g. 098 (3 digit no.)
3.	OEI sample letter	Name	e.g. C
4.	OEI station no.	From-To	e.g. 06 (2 digit no,)
5.	Direction from shoreline (from Grand Pass Timbalier)	Code	Code 01 North, into estuary 02 Northwest, into estuary 03 Northeast, into estuary 04 South, away from estuary 05 Southwest, away from estuary 06 Southeast, away from estuary
6.	Distance from shoreline	From-To	e.g. 0034 (4 digit number) (equals 3,4 miles)
7.	Latitude, North or South	Name	N or S
8.	Latitude	From-To	e.g. 285918 (6 digit no.)
9.	Longitude, East or West	Name	E or W
10.	Longitude	From-To	e.g. 0902254 (7 digit no.)
11.	Depth to bottom *(meters)*	From-To	e.g. 0025 (4 digit no.)
12.	Type of tow	Code	Code 1 opening-closing 2 oblique 3 surface 4 vertical
13.	Type of net	Name	e.g. N-J 1/2 m #8 (equals Niskin-Jones, 1/2 meter mouth opening, with #8 mesh size, 202 microns)
14.	Length of tow (minutes)	From-To	e.g. 30 (2 digit no.)
15.	Time nets in (on 24 hr. day)	From-To	e.g. 1035 (4 digit no.)
16.	Minimum depth of tow	From-To	e.g. 0004 (4 digit no.)
17.	Maximum depth of tOw	From-To	e.g. 0004 (4 digit no.)
18.	Year of collection	From-To	e.g. 1973

FIGURE 1-3. DESCRIPTION LIST (Sheet 1 of 2)

DESCRIPTOR		TYPE	EXAMPLE
19.	Month of collection	Code	Code 01 Jan 07 July 02 Feb 08 Aug 03 Mar 09 Sept 04 Apr 10 Ott 05 May 11 Nov 06 Jun 12 Dec
20.	Day of collection	From-To	e.g. 27 (2 digit no.)
21.	Salinity	From-To	e.g. 3236 (4 digit no.)
22.	Temperature	From-To	e. g. 2431 (4 digit no.)
23.	1st most abundant sp.	Name	e.g. P. crassirostris
24.	2nd most abundant sp.	Name	e. g. A. tonsa
25.	3rd most abundant sp.	Name	e. g. O. brevicornis
26.	Volume of water filtered (M^3)	From-To	e.g. 182 (3 digit no.)
27.	Total no. of individuals per cubic meter (copepods)	From-To	e.g. 09532 (5 digit no.)
28.	Diversity (computed) (Shannon-Weaver) (copepods)	From-To	e. g. 342 (3 digit no.)
29.	Total displacement volume (cc/m^3) (all zooplankton)	From-To	e.g. 00334 (4 digit no.)
30.	Copepod displacement volume (cc/m^3)	From-To	e. g. 00218 (4 digit no.) (equals 0.0218 cc/m^3)
31.	Reserve descriptor		
32.	Reserve descriptor		
33.	Reserve descriptor		
34.	Reserve descriptor		
35.	Reserve descriptor		
36.	Reserve descriptor		

FIGURE 1-3. DESCRIPTION LIST (Sheet 2 of 2)

BENTHIC
BIOMASS ANALYSIS SHEET

Research Vessel ________	Cruise No. ________	Station No. ________
		Date ______ Time ______
		Gear ________
		Depth ________

Foraminifera	Gastropoda	
Porifera	Bivalvia	
Hydrozoa	Cephalopoda	
Scyphozoa	Scaphopoda	
Stephanosc yphus	Polychaeta	
Actiniaria	Pycnogonid	
Gorgonaria	Copepoda	
Alcyonaria	Ostracoda	
Turbellaria	Mysidacea	
Nematoda	Cumacea	
Nemertina	Decapoda	
Ectoprocta	Tsopoda	
Brachiopoda	Amphipoda	
Pogonophora	Tanaidacea	
Kinorhyncha	Cirripedia	
Sipunculoidea	Ascidiacea	
Phoronida	Enteropneusta	
Priapuloidea	Cephalocordata	
Echiuroidea	Cyclostomata	
Asteroidea	Chondrichthes	
Ophiuroidea	Osteichthyes	
Echinoidea	Squid Beaks	
C rinoidea	Shark teeth	
Holothuroidea	Sediments	Volume ______
Aplacophora	$< 500\mu$ $< 250\mu$	O_2 ml/l ______
Monoplacophora	$> 250\mu$	Temp. ‘C. ______
Polyplacophora	Salinity 0/00 ______	

FIGURE 1-4. SAMPLE DATA SHEET (Sheet 1 of 3)

PLANKTON TOW DATA SHEET

Cruise: BT slide no.________

Date: Hydro. sta. no.______

Station no.: Other work on sta:

Sample no.:

Position: Lat. Long.

Local Time:

Type of tow (check) vertical surface oblique opening-closing___

Type of net: ½ m. #8 70 cm. F and WS _ Other (specify)______________

Length of tow ____ reins. Nets out: Nets in:

Wire Angle while fishing__°

Sample no.	Wire Out (m)	T-D no.	Fishing depth range	avg.	Flow meter no.	reading	vol. (m^3)

Comments:

FIGURE 1-4. SAMPLE DATA SHEET (Sheet 2 of 3)

PROJECT NO. OE 68 HJM

SAMPLE DATA SHEET

Station Description ____________________

Station # __________ Collector ____________________

Date __________ Time __________ Hours __________

Sector ______ Quadrant ______ Longitude ______ Latitude ______

Sample Location (Supplementary Information) ____________________

Sample Type: Surface _____ Mid-Depth _____ Bottom _____ Other ______

Sampling
Depth ______ Ft. Temp. ______ °C Salinity ______ - ppt Bottom Depth ______ Ft.

Current ______ @ ______ D. O. (Boat) ______ mg/ l D. O. (Winkler) ______ mg/ I

B, O. D. (______) ______ mg/ l C.O.D. ______ mg/ 1

Total Carbon	Inorganic Carbon	Organic Carbon
______ mg/ 1	______ mg/ 1	______ mg/ 1
______ mg/ 1	______ mg/ 1	______ mg/ 1
______ mg/ 1	______ mg/ 1	______ mg/ 1

Average

Remarks:

FIGURE 1-4. SAMPLE DATA SHEET (Sheet 3 of 3)

CRUISE ____________
PAGE ____________

PRODUCTIVITY STUDIES
OCEANOGRAPHY DEPARTMENT
TEXAS A&M UNIVERSITY

PROJECT NO. ____________
D.P. NO. ____________
DATE PUNCHED ____________

FIRST DATA CARD FORMAT

DATE xxxxxx (6)	STAT xxxx (10)	TIME (LOCAL) xxxx (14)	LAT. xxxxL (19)	LONG. xxxxxxL (26)	DEPTH (M) xxxx (30)	FLUORESCENCE SW xx. (32)	fo xx. (34)	fa xx. (36)	DLN xx (38)	OPTICAL DENSITY (630) .xxx (41)	(645) .xxx (44)	(665) .xxx (47)	(750) .xxx (50)	LIGHT BOTTLE xxxxxx (56)	DARK BOTTLE xxxx (60)	% LIGHT TRANS xxx (63)	Amt SW Filtered x.xx (66)	xxxxxxxxx (75)	CARD NO xxxxx (80)
201071	1	1130	3520S	15030W	0	3	35	22		205	030	02[illegible]	025	250	15	150	300		
211071	2	1015	3410S	15135W	0	10	56	40		007	040	035	031	465	19	150	250		

FIGURE 1-5. DATA CARD FORMAT

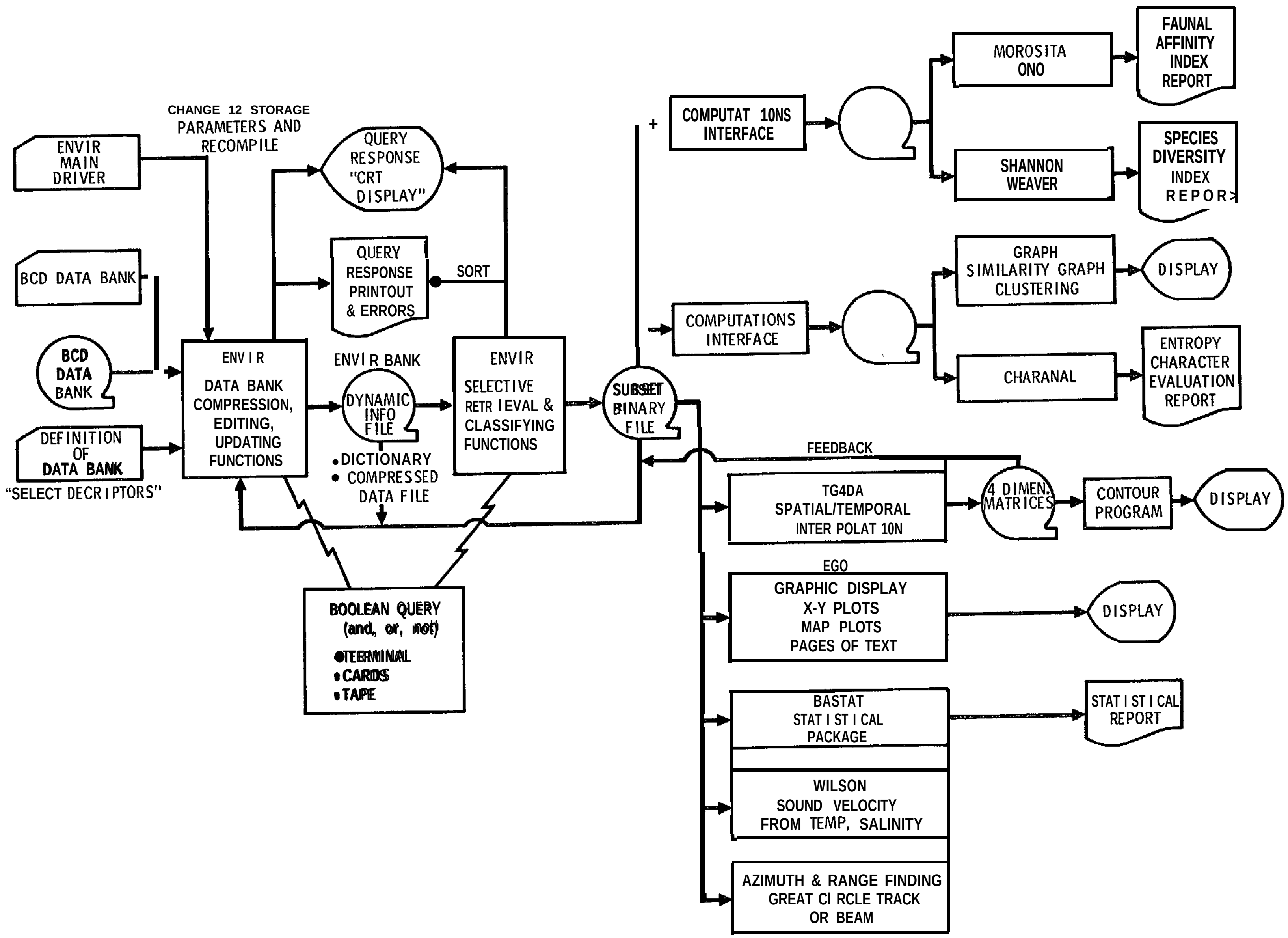


FIGURE 1-6. EDMPAS PROCESSING

1.3 Hardware Considerations

R emote terminals with CRT displays are operating by the system in either the interactive or batch modes. Other peripheral equipment includes direct access mass storage devices, magnetic tape drives, card readers, printers, punches, and on-line CALCOMP plotters.

EMPAS was originally developed for the Univac 1100 series computers. Since that time, it has been translated to the IBM 360/370 series computers at Rice University. It also has been translated to CDC 6000 series computers. The direct exchange of data from one computer system to another is facilitated through the exchange of compressed information tape files produced by ENVIR.

TABLE 1-1

APPLICATION MODULES

NAME	LANGUAGE	FUNCTION
TG4DA	FORTRAN V	The Topographically Guided 4-Dimensional Analysis program provides a technique for objective analysis, a process by which a set of synoptic randomly located observations of an environmental quantity, such as air temperature, are converted into an array of evenly spaced grid point values. Fields are defined and stored as 4-dimensional arrays with the inherent space-time continuity of the fields embodied in the mathematical definition of the arrays. The program interpolates in time, height (or depth) and other dimensions. The stored arrays are provided as output.
CHARANAL		The Character Analysis program will calculate the simple probability, conditional probability, the info rmation content of each character (parameter or descriptor) as well as the co r relation (redundancy) between characters without the restrictions of parametric statistics. It is founded on the principles of information theory (entropy) rather than mathematical probabilities.
GRAPH		The Similarity Graph Clustering program simulates the processes used by biologists

TABLE 1-1 (Continued)

NAME	LANGUAGE	FUNCTION
GRAPH (Continued)		to arrange and order items (species, environments, etc.) into a systematic order to show relationships and disjunctions.
SPECIES DIVERSITY		This module computes the species diversity index of a given region based on Shannon-Weaver information theoretic measure.
FAUNAL AFFINITY		This module computes the faunal affinity between samples or regions taking into consideration the common species and their relative abundance. (MOROSITA-ONO).
BASTAT	FORTRAN	The Basic Statistics program computes the mean value and standard deviation of fields selected by the user from the records contained in that file.
WILSON		This program used Wilson's equation to compute sound velocity from temperature and salinity data.
ARF		Module ARF is the current answer to the requirement of retrieving data subsets defined by a specified direction or range from a given reference point.
EGO	FORTRAN	This package of programs is designed for the display of data retrieved by ENVIR, in the form of cartes ian plots and maps, by means of a CAL comp plotter. Its output may take any of the following forms: functional-relation diagrams, s tatter diagrams, maps and pages of text.

2.0 NODC (NATIONAL OCEANOGRAPHIC DATA CENTER)

The National Oceanographic Data Center (NODC) is one of five major divisions of the Environmental Data Service, National Oceanic and Atmospheric Administration (NOAA), U. S. Department of Commerce. NODC serves the oceanographic data needs of researches in government, private institutions, and industry. NODC contains the world's largest useable collection of oceanographic data, receiving data for all oceans, seas, and estuaries from hundreds of sources, domestic and foreign. including the national data centers of other countries.

2.1 The NODC System

The NODC Data Base Management System, illustrated in Figure 2-1, can be described as library oriented, employing fixed record format files and producing a variety of standard outputs in tabular, punched card, magnetic tape and graphic form. Some statistical parameters such as minimum, maximum, nean and standard deviation are generated when requesting standard summary outputs. An interactive console (CRT) is currently in use at NODC which directs queries to the computer data base (station data file only) and prepares a quick, low-cost inventory of selected combinations of parameters for display. Terminals of a similar nature will be installed at the NODC liaison offices in the very near future.

Interdisciplinary requests for data can be serviced by NODC drawing from the data banks of the other four EDS facilities: National Climatic Center (NCC), National Geophysical and Solar-Terrestrial Data Center (NGSDC), Center for Experimental Design and Data Analysis (CEDDA), and the Environmental Science Information Center (ESIC), integrating that information with their own and offering output reports with referrals to other pertinent data sources outside NOAA. Through the use of the National Marine Data Inventory (NAMDI) and the Report of Observations /Samples Collected by Oceanographic Programs (ROSCOP), NODC acquires a comprehensive knowledge of worldwide data collection efforts that enhances its refer ral services.

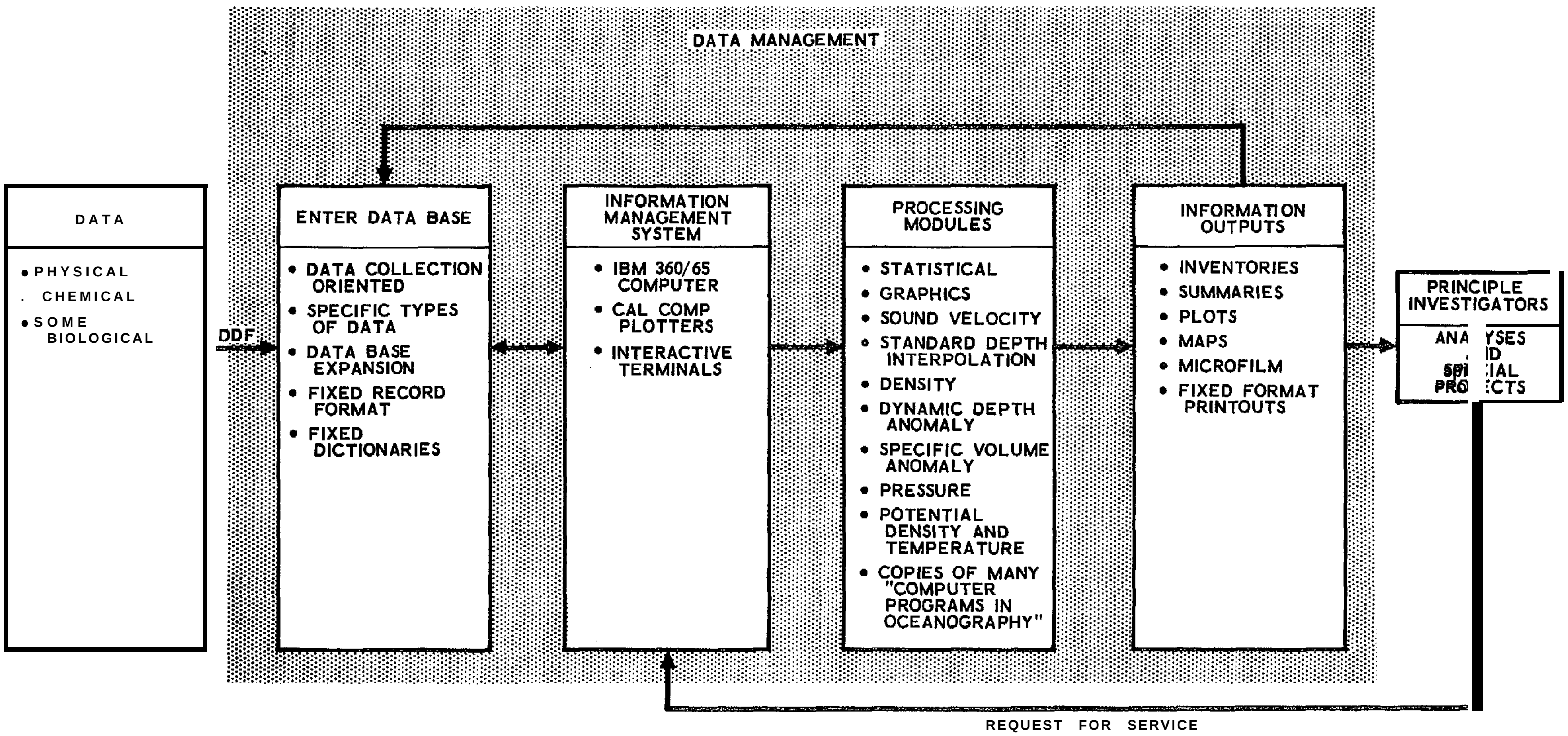


FIGURE 2-1. NATIONAL OCEANOGRAPHIC DATA CENTER (LIRBRARY ORIENTED SYSTEM)

2.2 NODC Data Base

NODC has established data bases from which information can be retrieved economically because of their modified inverted file structure. Files are maintained in both geographically and cruise sorted order. Data may be readily retrieved within these major categories to varying depths in the time domain. Currently, there are six major standard data files (fixed format) within the NODC data bank. These are described below. The process of NODC data acquisition, storage and manipulation is shown in Figure 2-2.

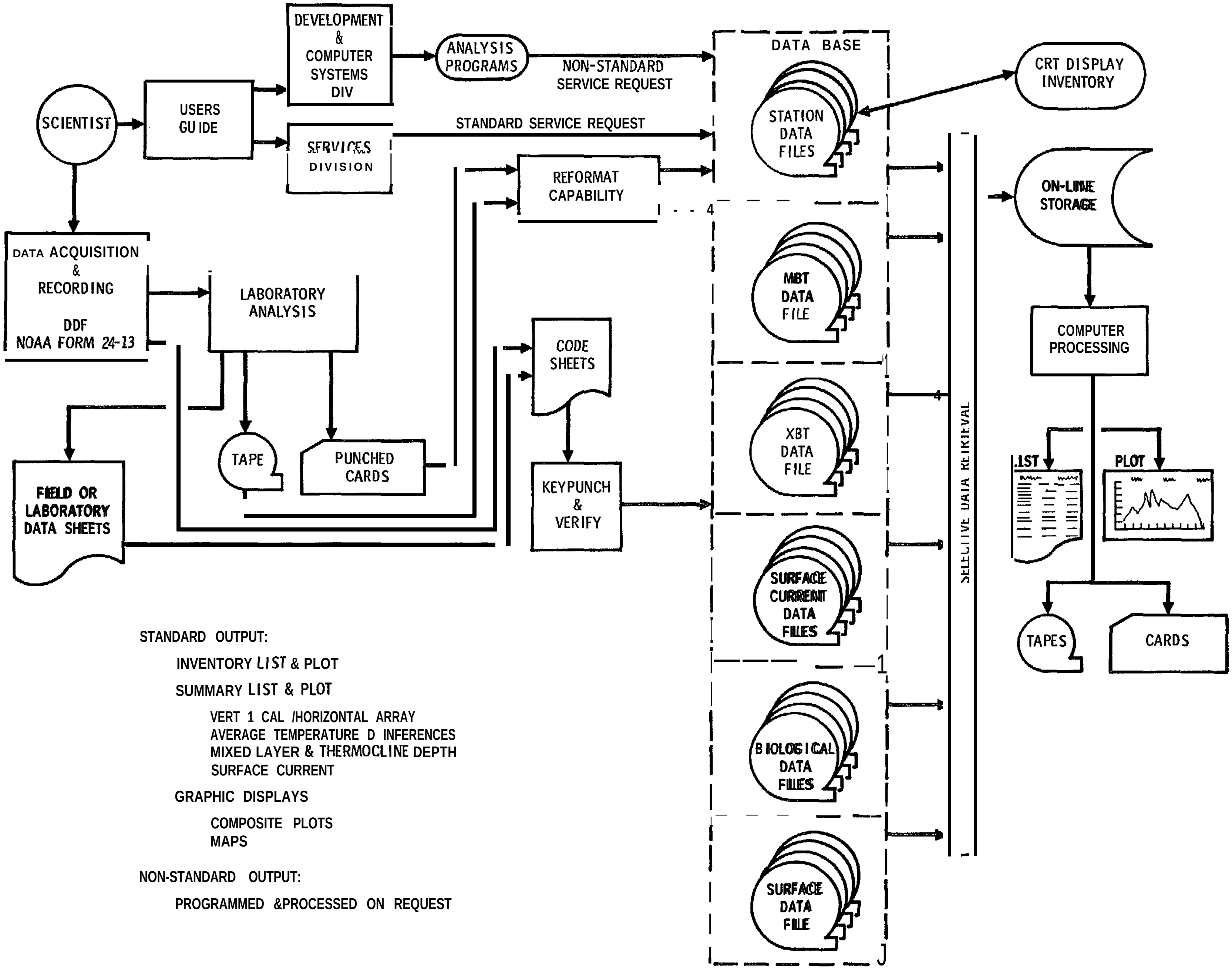
1. The Oceanographic Station Data Files contain primarily NANSEN casts supplemented with low resolution (>5 meter depth intervals) salinity-temperature-depth (STD) recorder data. This file contains supporting (cruise, position, date, time, etc.) information, recorded and/or analyzed raw data values and standard computed values of depth interpolation, density, sound velocity, dynamic depth anomaly, specific volume anomaly, pressure, potential temperature and potential density.

2. The Mechanical Bathythermograph (MET) Data file consists of digitized records of temperature, depth obtained from MBT slides, grids and the appropriate log sheets.

3. The Expendable Bathythermograph (XBT) Data file consists of digitized records of temperature, depth obtained from XBT strip charts and their associated log sheets.

4. Two Surface Current Data files contain data derived from ship drift information. A third file contains data derived from Drift Bottle and Seabed Drifters.

5. The two Biological Data files must be considered as separate entities for they are constructed differently and used in much different fashions.



STANDARD OUTPUT:

INVENTORY LIST & PLOT

SUMMARY LIST & PLOT

VERT 1 CAL /HORIZONTAL ARRAY
AVERAGE TEMPERATURE D INFERENCES
MIXED LAYER & THERMOCLINE DEPTH
SURFACE CURRENT

GRAPHIC DISPLAYS

COMPOSITE PLOTS
MAPS

NON-STANDARD OUTPUT:

PROGRAMMED &PROCESSED ON REQUEST

FIGURE 2-2. NODC PROCESSING

a. The Cruise Data holdings are data acquired from some 600 cruises containing one or more types of the following information: phytoplankton, phyto-plankton pigments, primary productivity, and zooplankton. The Biological Data file contains about 25 percent of these data holdings in a standard format and the remainder of the data can be retrieved manually as copies of the originators formats.

b. The Biological literature file contains coded, indexed contents of over 12, 000 biological documents, computer retrievable, using the Biological Information Retrieval System -- a bibliographic retrieval system which uses the General Information Processing System (GIPSY) developed by the University of Oklahoma.

6. The Surface Data file contains selected surface physical/chemical data to an arbitrary depth of ten meters, plus meteorological parameters.

2.3 Data Manipulation

NODC is able to retrieve data from its established data bases and to reformat, compute, plot, graph and provide data in a variety of forms (computer printouts, plots, microfilm, cards or magnetic tapes) to meet user requirements. Certain file inventories are routinely produced by NODC as a guide to the areas, seasons, cruise numbers, and scientific parameters contained in those files. These inventories are in the form of computer produced world-wide or local area maps and listings. Certain computed parameters are routinely produced and stored in the standard files with the observed data, other parameters or statistics can be generated for output by means of the following software modules:

Plot Capabilities

- **Bathythermograph Composite Plot**

  Computes number of observations at 50 meter intervals. Plots by season and area.

- **Cruise Track - Mercator Projection**

  Plots to a maximum of 600 stations in a cruise (a new multi-Projection program is being developed).

- **Density - Salinity Midpoint Plot**

  Construsts single plots and composite plots of selected density-salinity values. Composite plots enable analysis of mid-point values in relation to their surroundings.

- **Geological Sample Inventory Plot**

  Displays inventory data and location in an array of Marsden squares.

- **Inventory Plot**

  Displays an inventory of station data, BT data, geological data, or any geographically sorted data file by 1, 2, 5 degree squares on any of eight map projections.

- **Salinity Deviation Plot**

  The deviations of salinity from related models are computed and a salinity profile is plotted.

- **Sigma-t vs. Depth, Salinity Plot**

  Displays sigma-t versus depth and salinity composite by Marsden squares.

- **Sound Velocity Depth Profiles**

  Displays curves of depth versus sound velocities for selected seasons or months.

- **Subroutine MAP**

  Provides a wide variety of map projections and grids to facilitate the display of geographical data.

- **Vertical Section Plot**

  Displays single contours of temperature, salinity, sigma-t, gymnodinium breve, inorganic phosphorus, total phosphorus, nitrogen, silicon, or copper. Also plots vertical sections with numerical values for inorganic phosphorus, total phosphorus, silicon, or copper.

Compute and List Program Capabilities

- BT Converter

  Converts BT data from feet to fathoms and meters and Fahrenheit to Celsius degrees, and interpolates these values at standard depths.

- BT Output

  Lists BT data as stored in the data base with a standard output format.

- Density - Salinity Interpolation

  Using selected values to represent the water mass midpoints, it performs a linear interpolation to predetermined increments.

- Drift Bottle Computation

  Computes bearing, miles drifted, days adrift, speed, and Marsden squares of release point from bottle recovery information.

- Gradient Summary

  Computes and prints the average temperature gradients for each 20 meter depth interval by month.

- Ocean Station Data Interpolation

  Interpolates depth, temperature, and salinity at isotropic levels.

- Specific Volume Anomoly

  Computes specific volume and dynamic depth anomalies at observed levels. Specific volume anomolies are interpolated to standard depths and used to compute dynamic depth anomolies at the standard depths.

- Ocean Station Data Output

  Retrieves and prints station data as stored in the data bank in a standard format.

- Ocean Station Depth Summary

  Summarizes depth to the bottom and maximum sample information giving a tally of the number of stations with maximum samples within given intervals.

- **Sea Sense Limit**

  Evaluates NOMAD buoy data and lists each of the five meteorological parameters. A histogram for each month is also generated.

- **Sea Sense Limit**

  Compares NOMAD buoy data with established norms. Computes percent of wind speeds in each Beaufort category, percent of wind direction in each of nine established categories and prints versus normals. The means are also listed versus the normals.

- **Sea Sense Standard Deviation**

  Using NOMAD buoy data, computes means and standard deviations for each of the five meteorological parameters. These values are also computed on the differences between NOMAD and map data (if available).

- **Station Data Compute**

  Computes sigma-t, sound velocity, specific volume and dynamic depth anomolies using interpolated values for temperature and salinity.

- **Station Data Inventory**

  Lists geosorted station data, computes and lists depth to bottom, maximum sample depth, water color transparency codes, maximum depth of sound velocities, minimum depth, and arithmetic average of vertical sample spacing.

- **Vertical Array Summary**

  Computes maximum and minimum values, number of observations, means and standard deviations at standard levels for any combination of six parameters of ocean station data (temperature, salinity, sigma-t, oxygen, sound velocity, dynamic depth).

- **Surface Current Summary**

  Computes, by Marsden square, resultant current speed and directions by month.

- **Thermocline and Mixed Layer Depths**

  Computes depths of the mixed layer, top of thermocline for BT observations, and means for each month by Marsden square.

2.4 Hardware Configuration

The NODC complex in Washington, D. C. contains an IBM 360/65 which is the processing capability for both NODC and World Data Center - A (WDC-A). The 360/ 65 currently has a two million byte storage capability with another one -half million bytes to be added in the near future. There are fourteen (14) tape drives, twelve {12) of which are nine track, dual density (800, 1600 bli) and two (2) are seven track, dual density (556, 800 bpi). Auxiliary on-line storage capabilities consist of sixteen (16) disc files, IBM 3330 compatible, that remain permanently mounted within the operating system and eight (8) disc files, IBM 2314 compatible, that are interchangeably mounted as the various tasks require. Three high speed printers provide the s ystem's listing outputs and a Calcomp Plotter (model 763), is used in an off-line mode, provides the plot output from various Oceanography Data Programs.

2.5 NODC Data Forms and File Formats

Standard NODC data forms and file formats used by NODC are presented in the following figures:

- Data Documentation Form-DDF (Figure 2-3)

  A standard form designed to facilitate the data reporting function. It must accompany all data sent to NOAA for incorporation in the national data bank.

- Report of Observations /Samples Collected by Oceanographic Programs - ROSCOP (Figure 2-4)

  A standard inventory or cruise report form summarizing the numbers and types of samples gathered by an investigator.

- Biological Information System Coding Sheets (Figure 2-5)

  The vehicle for recording biological information for storage on the NODC Biological Inventory Retrieval System.

- Oceanographic Station Data File Format (Figure 2-6)

- Mechanical Bathythermograph Data File Format (Figure 2-7)

		ACCESSION NUMBER	

DATA DOCUMENTATION FORM

NOAA FORM 24-13
(6-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEANOGRAPHIC DATA CENTER
RECORDS SECTION
ROCKVILLE, MARYLAND 20852

FORM APPROVED
O.M.B. No. 41-R...

This form should accompany all data submissions to NODC. Section A, Originator Identification, must be completed when the data are submitted. It is highly desirable for NODC to also receive the remaining pertinent information at that time. This may be most easily accomplished by attaching reports, publications, or manuscripts which are readily available describing data collection, analysis, and format specifics. Readable, handwritten submissions are acceptable in all cases. All data shipments should be sent to the above address.

A. ORIGINATOR IDENTIFICATION

THIS SECTION MUST BE COMPLETED BY DONOR FOR ALL DATA TRANSMITTALS

1. NAME AND ADDRESS OF INSTITUTION, LABORATORY, OR ACTIVITY WITH WHICH SUBMITTED DATA ARE ASSOCIATED

2. EXPEDITION, PROJECT, OR PROGRAM DURING WHICH DATA WERE COLLECTED

3. CRUISE NUMBER(S) USED BY ORIGINATOR TO IDENTIFY DATA IN THIS SHIPMENT

4. PLATFORM NAME(S)

5. PLATFORM TYPE(S) (E.G., SHIP, BUOY, ETC.)

6. PLATFORM AND OPERATOR NATIONALITY(IES)

PLATFORM	OPERATOR

7. DATES

FROM: MO/DAY/YR	TO: MO/DAY/YR

8. ARE DATA PROPRIETARY?

☐ NO ☐ YES

IF YES, WHEN CAN THEY BE RELEASED FOR GENERAL USE? YEAR MONTH _

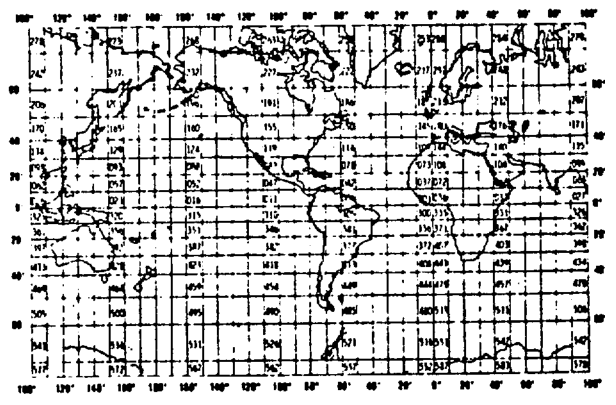
9. ARE DATA DECLARED NATIONAL PROGRAM (DNP)?
(I.E., SHOULD THEY BE INCLUDED IN WORLD DATA CENTERS HOLDINGS FOR INTERNATIONAL EXCHANGE?)

☐ NO ☐ YES ☐ PART (SPECIFY BELOW)

10. PERSON TO WHOM INQUIRIES CONCERNING DATA SHOULD BE ADDRESSED WITH TELEPHONE NUMBER (AND ADDRESS IF OTHER THAN IN ITEM 1)

11. PLEASE DARKEN ALL MARSDEN SQUARES IN WHICH ANY DATA CONTAINED IN YOUR SUBMISSION WERE COLLECTED.

GENERAL AREA



NOAA FORM 24-13

USCOMM-DC 44285-P

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 1 of 7)

B. SCIENTIFIC CONTENT

Include enough information concerning manner of observation, instrumentation, analysis, and data reduction routines to make them understandable to future users. Furnish the minimum documentation considered relevant to each data type. Documentation will be retained as a permanent part of the data and will be available to future users. Equivalent information already available may be substituted for this section of the form (i.e., publications, reports, and manuscripts describing observational and analytical methods). If you do not provide equivalent information by attachment, please complete the scientific content section in a manner similar to the one shown in the following example.

EXAMPLE (HYPOTHETICAL INFORMATION)

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURE	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Salinity	‰	Nansen bottles	Inductive salinometer (Hytech model S510)	N/A (Not applicable)
		STD Bissett-Berman Model 9006	N/A	Values averaged over 5-meter intervals
Water color	Forel scale	Visual comparison with Forel bottles	N/A	N/A
Sediment size	φ units and percent by weight	Ewing corer	Standard sieves. Carbonate fraction removed by acid treatment	Same as "Sedimentary Rock Manual," Folk '65

(SPACE IS PROVIDED ON THE FOLLOWING TWO PAGES FOR THIS INFORMATION)

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 2 of 7)

8. SCIENTIFIC CONTENT

NAME OF DATA FIEL	REPORTING UNITS OR COOL?	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING

NA FORM 24-13 (3-72) USCOMM-DC 44283 P7

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 3 of 7)

C. DATA FORMAT

This information is requested only for data transmitted on punched cards or magnetic tape. Have one of your data processing specialists furnish answers either on the form or by attaching equivalent readily available documentation. Identify the nature and ❑ eaning of all entries and explain any codes used.

1. List the record types contained in your file transmittal (e.g., tape label record, master, detail, standard depth, etc.).

2. Describe briefly how your file is organized.

3-13. Self-expl anatory.

14. Enter the field name as appropriate (e.g.,. header information, temperature, depth, salinity.

1s. Enter starting position of the field.

16. Enter field length in number columns and unit of measurement (e.g., bit, byte, character, word) in unit column.

17. Enter attributes as ● xpressed in the programming language specified in item 3 (e.g., "F 4.1," "BINARY FIXED (5.1)").

18. Describe field. If sort field, enter "SORT 1" for first, "SORT 2'" for second, etc. If field is repeated, state number of times it is repeated.

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 4 of 7)

C. DATA FORMAT

COMPLETE THIS SECTION FOR PUNCHED CARDS OR TAPE, MAGNETIC TAPE, OR DISC SUBMISSIONS.

1. LIST RECORD TYPES CONTAINED IN THE TRANSMITTAL OF YOUR FILE
GIVE METHOD OF IDENTIFYING EACH RECORD TYPE

2. GIVE BRIEF DESCRIPTION OF FILE ORGANIZATION

3. ATTRIBUTES AS EXPRESSED IN ☐ PL-1 ☐ ALGOL ☐ COBOL
☐ FORTRAN ☐ ________ LANGUAGE

4. RESPONSIBLE COMPUTER SPECIALIST:
NAME AND PHONE NUMBER ________
ADDRESS ________

COMPLETE THIS SECTION IF DATA ARE ON MAGNETIC TAPE

RECORDING MODE	☐ BCD ☐ BINARY ☐ ASCII ☐ EBCDIC ☐ ________	9. LENGTH OF INTER-RECORD GAP (IF KNOWN)	☐ 3/4 INCH ☐ ________
NUMBER OF TRACKS (CHANNELS)	☐ SEVEN ☐ NINE ☐ ________	10. END OF FILE MARK	☐ OCTAL 17 ☐ ________
PARITY	☐ ODD ☐ EVEN	11. PASTE-ON-PAPER LABEL DESCRIPTION *(INCLUDE ORIGINATOR NAME AND SOME LAY SPECIFICATIONS OF DATA TYPE. VOLUME NUMBER)*	
DENSITY	☐ 200 BPI ☐ 1600 BPI ☐ 556 BPI ☐ 800 BPI ☐ ________	12. PHYSICAL BLOCK LENGTH IN BYTES 13. LENGTH OF BYTES IN BITS	

FAA FORM 24-13 USCOMM-DC 44289-P7

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 5 of 7)

RECORD FORMAT DESCRIPTION

RECORD NAME

FIELD NAME	POSITION FROM -.! MEASUREC IN (e.g., bits, bytes)	LENGTH		ATTRIBUTES	USE AND MEANING
		IMBER	IN ITS		

OAA FORM 24-13

USCOMM-DC 44289-P

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 6 of 7)

0. INSTRUMENT CALIBRATION

This calibration information will be utilized by NOAA's National Oceanographic Instrumentation Center in their efforts to develop calibration standards for voluntary acceptance by the oceanographic community. Identify the instruments used by your organization to obtain the scientific content of the DDF (i.e., STD, temperature and pressure sensors, salinometers, oxygen meters, velocimeters, etc.) and furnish rhe calibration data requested by completing and/or checking (**#" ') the appropriate spaces. Add the interval rime (i.e., 3 months, 6 months, 9 months, etc.) if the fixed interval calibration cycle is checked.

INSTRUMENT TYPE (MFR.. MODEL NO.)	DATE OF LAST CALIBRATION	INSTRUMENT WAS CALIBRATED BY		CHECK ONE: INSTRUMENT IS CALIBRATED					INSTRUMENT IS NOT CALIBRATED (√)
		YOUR ORGANIZATION (√)	OTHER ORGANIZATION (GIVE NAME)	AT FIXED INTERVALS (√)	BEFORE on AFTER USE (√)	BEFORE ANO AFTER USE (√)	ONLY AFTER REPAIR (√)	ONLY WHEN NEW (√)	

FIGURE 2-3. DATA DOCUMENTATION FORM (Sheet 7 of7)

NOAA FORM 24-23 (4-74)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE
NATIONAL OCEANOGRAPHIC DATA CENTER

FORM APPROVED
O.M.B. NO 41-R2765
EXPIRES 12-31-79

REPORT OF OBSERVATIONS/SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMS (ROSCOP II)

PREPARED FOR USE BY U.S. ACTIVITIES IN ACCORDANCE WITH SPECIFICATIONS OF THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

SECTION A - GENERAL INFORMATION PLEASE READ INSTRUCTIONS ON COVER BEFORE COMPLETING THIS FORM

DATA CENTER 01	REFERENCE NUMBER 02	COUNTRY 03	COUNTRY CODE (For Data Center use)

INSTITUTION 04

SHIP/PLATFORM 05	RADIO CALL SIGN 06	PLATFORM TYPE 07

CRUISE NUMBER/NAME 08	EXPEDITION/PROJECT 09

CHIEF SCIENTIST(S) 10	START DATE (YEAR, MO., DAY) 11	END DATE (YEAR, MO., DAY) 12

TYPE OF MARINE ZONES (Optional) 13	GENERAL OCEAN AREA (Optional) 14	DECLARED NATIONAL PROGRAM (If part, specify in "Remarks") 15 YES / NO / PART

EXCHANGE RESTRICTED (If part, specify in "Remarks") 16 YES / NO / PART	COOPERATIVE PROGRAM 17 YES / NO	PROGRAM NAME 18

INTERNATIONALLY COORDINATED 19 YES / NO	BY WHOM 20

FIXED STATION	LATITUDE 21 ° '	LONGITUDE 22 ° '	QUADRANT: 23	NE 1	SE 3	SW 5	NW 7

FEDERAL SUPPORT 24

DISPOSITION OF DATA

CODE	25 WHOM TO QUERY	CODE	26 FINAL DISPOSITION
01		51	
02		52	
03		53	
04		54	
05		55	
06		56	
07		57	
08		58	
09		59	
10		60	

SECTION B

DISCIPLINE/PARAMETER (Parameter entries are optional)	27 GEOGRAPHIC LOCATION (If more space is needed, use blank paper)											
	10° x 10° SQUARES			1° x 1° SQUARES (Recommended but not mandatory)								
	Qc	La	LoLo	1° x 1°	1° x 1°	1° x 1°	1° x 1°	1° x 1°	1° x 1°	1° x 1°	1° x 1°	1° x 1°
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											
A	B											

FIGURE 2-4. REPORT OF OBSERVATIONS/SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMS-ROSCOP (Sheet 1 of 4)

SECTION C PARAMETERS MEASURED/TYPES OF STUDIES	(CODE)	NUMBER	QUERY	FINAL ISPOSITION	FORMAT
M-METEOROLOGY					
UPPER AIR OBSERVATIONS	M01				
INCIDENT RADIATION	M02				
AI R-SEA INTERFACE STUDIES	M03				
ICE OEE.ERVATIONS	M04				
OCCASIONAL STANDARD MEASUREMENTS	MOE				
SYSTEMATIC STANDARD MEASUREMENTS	M06				
OTHER MEASUREMENTS *(Specify in* 'Remarks")	M90				
H-PHYSICAL/CHEMICAL oCEANOGRAPHY					
HS-SURFACE					
CONTINUOUS TEMPERATURE RECORDING	H01				
CONTINUOUS SALINITY RECORDING	H 02				
DISCRETE TEMPERATURE MEASUREMENTS	H03				
DISCRETE SALINITY MEASUREMENTS	H04				
HB-NEAR BOTTOM *(≤ 10m. from bottom)*					
CoNTINUouS TEMPERATURE RECORDING	HOE				
CONTINUOUS SALINITY RECORDING	H06				
DISCRETE TEMPERATURE MEASUREMENTS	H07				
DISCRETE SALINITY MEASUREMENTS	H08				
HP-PHYSICAL					
CLASSICAL OCEANOGRAPHIC STATIONS	H09				
VERTICAL PROFILES *(STD/CTD)*	H1o				
MEASUREMENT; NEAR SEA FLOOR	H11				
MECHANICAL BATHYTHERMGRAPH *(Number of drops)*	H12				
EXPENDABLE BATHYTHERMOGRAPH *(Number of drops)*	H13				
SOUND VELOCITY STATIONS	H14				
ACOUSTIC STATIONS	H15				
TRANSPARENCY	N16				
OPTics	H17				
DIFFUSION *(Dynamic)*	H 18				
OTHER MEASUREMENTS *(Specify in "Remarks")*	N90				
MC-CHEMICAL					
OXYGEN	H21				
PHOSPHATES	H22				
TOTAL.- P	H23				
NITRATES	H24				
NITRITES	H 2S				
SILICATES	H26				
ALKALINITY	H27				
pH	H2S				
CHLORINITY	H29				
TRACE ELEMENTS	H30				
RADIOACTIVITY	H31				
ISOTOPES	H32				
DISSOLVED GASES	H33				
OTHER MEASUREMENTS *(Specify in "Remarks")*	H90				
P-POLLUTION					
SUSPENDED SOLIDS	P01				
HEAVY METAL3	P02				
PETROLEUM RESIDUES	P03				
CHLORINATED HYDROCARBONS	P04				
oTHER DISSOLVED SUBSTANCES	P03				
THERMAL POLLUTION	PM				
WASTE WATER: BOO	P07				
WASTE WATER: NITRATES	P08				
WASTE WATER: MICROBIOLOGY	P09				
WASTE WATER: OTHER	P10				
DISCOLORED WATER	P11				
BoTTOM DEPOSITS	P12				
CONTAMINATE oRGANISMS	P13				
OTHER MEASUREMENTS *(Specify in "Remark")*	P90				

FIGURE 2-4. REPORT OF OBSERVATIONS/SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMS -ROSCOP (Sheet 2 of4)

SECTION C PARAMETERS MEASURED TYPES OF STUDIES	CODE	NUMBER	QUERY	FINAL DISPOSITION	FORMAT
G-GEOLOGY GEOPHYSICS					
GL-MEASUREMENTS MADE AT A SPECIFIC LOCATION					
DREDGE	G01				
GRAB	G02				
CORE -ROCK *(Number of cores)*	G03				
CORE -SOFT BOTTOM *(Number of cores)*	G04				
SAMPLING BY DIVERS	G05				
SAMPLING BY SUBMERSIBLE	G06				
DRILLING	G07				
BOTTOM PHOTOGRAPHY	G08				
SEA FLOOR TEMPERATURE *(≤ 1m. from bottom)*	G09				
ACOUSTICAL PROPERTIES OF THE SEA FLOOR	G10				
ENGINEERING PROPERTIES OF THE SEA FLOOR	G11				
MAGNETIC PROPERTIES OF THE SEA FLOOR	G12				
GRAVIMETRIC PROPERTIES OF THE SEA FLOOR	G13				
RADIOACTIVITY MEASUREMENTS	G14				
OTHER MEASUREMENTS *(Specify in "Remarks")*	G70				
GU-MEASUREMENTS UNDERWAY					
MOTION PICTURE OF THE SEA FLOOR	G21				
BATHYMETRY-WIDE BEAM *(Number of miles)*	G22				
BATHYMETRY-NARROW BEAM *(Number of miles)*	G23				
SIDE-SCAN SONAR	G24				
SEISMIC REFLECTION	G25				
SEISMIC REFRACTION	G26				
GRAVIMETRY	G27				
MAGNETISM	G28				
OTHER MEASUREMENTS (Specify in *"Remarks"*)	G80				
GS-TYPES OF STUDIES					
PHYSICAL ANALYSIS OF SEDIMENTS	G31				
CHEMICAL ANALYSIS OF SEDIMENTS	G32				
PALEONTOLOGY	G33				
PALEOMAGNETISM/ROCK MAGNETISM	G34				
PALEOTHERMY	G35				
GEOTHERMY	G36				
GEOCHRONOLOGY	G37				
MINERAL AND FOSSIL RESOURCES	G38				
LITTORAL ZONE STUDIES	G39				
OTHER MEASUREMENTS *(Specify in "Remarks")*	G40				
D-DYNAMICS					
CURRENT METERS *(Number of stations)*	D01				
CURRENT METERS *(Average duration of measurements)*	D02				
CURRENTS MEASURED FROM SHIP DRIFT	D03				
GEK	D04				
DRIFTERS *(Number)*	D05				
SWALLOW FLOATS *(Number)*	D06				
DRIFT CARDS (Number *released)*	D07				
BOTTOM DRIFTERS *(Number released)*	D08				
TIDAL OBSERVATIONS *(Duration)*	D09				
SEA AND SWELL *(Number of observations)*	D10				
OTHER MEASUREMENTS *(Specify in "Remarks")*	D50				
B-BIOLOGY					
PRIMARY PRODUCTIVITY	B01				
PHYTOPLANKTON PIGMENTS	B02				
SESTON	B03				
PARTICULATE ORGANIC CARBON	B04				
PARTICULATE ORGANIC NITROGEN	B05				
DISSOLVED ORGANIC MATTER	B06				
PELAGIC BACTERIA AND MICROORGANISMS	B07				
PHYTOPLANKTON	B08				
ZOOPLANKTON	B09				
NEUSTON	B10				

FIGURE 2-4. REPORT OF OBSERVATIONS/SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMS-ROSCOP (Sheet 3 of 4)

SECTION	PARAMETERS MEASURED TYPES OF STUDIES	CODE	NUMBER	QUERY	FINAL DISPOSITION	FORMAT
B-BIOLOGY (Continued)						
	NEKTON	B11				
	INVERTEBRATE NEKTON	B12				
	PELAGIC EGGS AND LARVAE	B13				
	PELAGIC FISHES	B14				
	AMPHIBIANS	B15				
	BENTHIC BACTERIA AND MICROORGANISMS	B16				
	PHYTOBENTHOS	B17				
	ZOOBENTHOS	B18				
	COMMERCIAL DEMERSAL FISHES	B19				
	COMMERCIAL BENTHIC MOLLUSCS	B20				
	COMMERCIAL BENTHIC CRUSTACEANS	B21				
	ATTACHED PLANTS AND ALGAE	B22				
	INTERTIDAL ORGANISMS	B23				
	BORERS AND FOULERS	B24				
	BIRDS	B25				
	MAMMALS AND REPTILES	B26				
	DEEP SCATTERING LAYERS	B27				
	ACOUSTICAL REFLECTIONS ON MARINE ORGANISMS	B28				
	BIOLOGICAL SOUNDS	B29				
	BIOLUMINESCENCE	B30				
	VITAMIN CONCENTRATIONS	B31				
	AMINO ACID CONCENTRATIONS	B32				
	HYDROCARBON CONCENTRATIONS	B33				
	LIPID CONCENTRATIONS	B34				
	ATP-ADP-AMP CONCENTRATIONS	B35				
	DNA-RNA CONCENTRATIONS	B36				
	TAGGINGS	B37				
	OTHER MEASUREMENTS (Specify in "Remarks")	B90				
	B5-TYPE OF STUDIES					
	IDENTIFICATION	B51				
	SPATIAL AND TEMPORAL DISTRIBUTION	B52				
	MONITORING AND SURVEILLANCE	B53				
	BIOMASS DETERMINATION	B54				
	DESCRIPTION OF COMMUNITIES	B55				
	FOOD CHAINS ENERGY TRANSFERS	B56				
	POPULATIONS AND ENVIRONMENTS	B57				
	POPULATION STRUCTURES	B58				
	TAXONOMY, SYSTEMATIC, CLASSIFICATION	B59				
	PHYSIOLOGY	B60				
	BEHAVIOR	B61				
	PATHOLOGY, PARASITOLOGY	B62				
	TOXICOLOGY	B63				
	GEAR RESEARCH	B64				
	EXPLORATORY FISHING	B65				
	COMMERCIAL FISHING	B66				
	AQUACULTURE	B67				
	OTHER MEASUREMENTS (Specify in "Remarks")	B90				

REMARKS *(Please use plain sheets of paper, if additional space is required.)*

FIGURE 2-4. REPORT OF OBSERVATIONS/ SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMS-ROSCOP (Sheet 4 of 4)

Biological information system coding sheet

NODC BIOLOGICAL INFORMATION RETRIEVAL SYSTEM

LIBRARY

ACCESSION NO. A<N > YEAR B< >

AUTHORS C <

TITLE D<

CITATION E <

GENERAL AREA F< AR; NW; NE; SW; SE; NA; SA; IN; AN;

BL; ME >

MARSDEN SQUARES G<

>

H<SC–

DO NOT PUNCH

INDEXER

DATE REC'D

DATE INDEXED

REVIEWER

DATE REV'D

FIGURE 2-5. BIOLOGICAL INFORMATION SYSTEM CODING SHEETS (Sheet 1 of 5)

Biological information system coding sheet--continued

AQUACULTURE—AQ

- AERATION SYSTEMS
- ARTIFICIAL FEEDS
- ARTIFICIAL TANKS
- FERTILIZED WATERS
- FISH FARMS
- NATURAL RESERVOIRS
- NURSERY GROUNDS
- SHELLFISH PONDS
- SEA WATER SYSTEMS
- SURVIVAL

BEHAVIOR—BE

BIOCHEMISTRY OF ORGANISMS—BI

- ABSORPTION SPECTRA
- ASH CONTENT ANALYSES
- BIOCHEMICAL COMPOSITION
- BIOCHEMICAL ENERGETICS
- BIOCHEMISTRY OF PHOTOSYNTHESIS
- BLOOD CHEMISTRY
- DEGRADATION
- FERMENTATION
- FLUORESCENCE
- NP
- NUTRIENT CYCLES
- NUTRIENT DISTRIBUTION
- NUTRIENT FIXATION
- NUTRIENT STUDIES
- RESPIRATION
- SYNTHESIS
- UPTAKE OF INORGANIC SUBSTANCES
- AMINO ACIDS*
- ANIMAL HORMONES*
- ANIMAL PIGMENTS*
- CARBOHYDRATES*
- CAROTENOIDS*
- CHLOROPHYLL A
- CHLOROPHYLL B
- CHLOROPHYLL C
- COENZYMES*
- ENZYMES*
- LIPIDS*
- NUCLEIC ACIDS*
- PLANT HORMONES*
- PLANT PIGMENTS*
- PROTEINS*
- TOXINS*
- VITAMINS*

BIODETERIORATION—DT

- BIOCIDES
- BIOEROSION
- BIOLOGICAL CORROSION
- CHEMICAL CONTROL
- CONTROL TESTS*
- DETERIORATION
- FOULING ORGANISMS
- MARINE BORERS
- MATERIALS*
- NATURAL CONTROL
- PHYSICAL CONTROL
- WOOD BORERS

BIOLUMINESCENCE—BL

- CHEMISTRY OF BIOLUMINESCENCE
- LUMINESCENT ORGANS
- MEASUREMENTS OF BIOLUMINESCENCE
- SIGNIFICANCE OF BIOLUMINESCENCE

CHEMISTRY OF SEA WATER—CH

- ARTIFICIAL SEA WATER
- BIOGEOCHEMICAL CYCLES
- BUFFERS
- CHEMICAL ELEMENTS*
- COMPLEXED ORGANIC COMPOUNDS
- DISSOLVED OR FREE GASES
- DISSOLVED ORGANIC MATTER
- EXCRETORY PRODUCTS
- FECAL MATERIALS
- INORGANIC ACIDS*
- METABOLITES*
- NUTRIENTS*
- ORGANIC ACIDS*
- ORGANIC DETRITUS
- PARTICULATE ORGANIC MATTER

CULTURES OF PLANTS—CU

- ALGAL CULTURES
- BACTERIAL CULTURES
- CLOSED CULTURES
- FUNGAL CULTURES
- GROWTH STUDIES IN CULTURE
- INCUBATION TECHNIQUES
- PURE CULTURES
- VIRAL CULTURES
- YEAST CULTURES

ECOLOGICAL SYSTEMS—EC

- ANNUAL CROP
- ECOSYSTEMS
- ENERGY BUDGETS
- MICROCOSMS
- PALEOECOLOGY
- REDOX POTENTIAL
- REHABILITATION
- STANDING CROP
- SUCCESSION
- THEORETICAL MODELS
- TRANSPLANTATION

ENVIRONMENTAL FACTORS—EF

- ACCLIMATIZATION
- ASTRONOMICAL PHENOMENA
- DENSITY
- DEPTH
- DESICCATION
- DESTRUCTIVE ACTION OF SEA
- DIFFUSION RATE
- EVAPORATION
- EXPLOSIVES
- EXPOSURE
- FOOD AVAILABILITY
- ILLUMINATION
- LIGHT PENETRATION
- MONSOON
- MOON
- OXYGEN DEFICIENCY
- pH
- POLARIZED LIGHT
- POWER PLANTS
- PRECIPITATION
- PRESSURE
- SALINITY
- SPECIFIC GRAVITY
- SUBSTRATUM COMPOSITION
- TEMPERATURE
- TURBIDITY
- WEATHER
- WIND

ENVIRONMENT TYPES—ET

- AERIAL
- ANAEROBIC ENVIRONMENTS
- BAYS
- BENTHIC
- BIOLOGICAL DESERT AREAS
- BRACKISH WATER
- CANALS
- CAVES
- DAMS
- DRAINAGE RECLAMATION
- ENVIRONMENT CONSERVATION
- ESTUARIES
- FAULTS
- FJORDS
- GLACIERS
- HARBORS
- ICE
- ICE ISLANDS
- INTERTIDAL
- ISLANDS
- LAGOONS
- LAKES
- MARSHES
- MEIOBENTHIC
- NERITIC
- OCEANIC
- REEFS
- ARTIFICIAL REEFS
- SEA MOUNTS
- SEDIMENTS
- SHELF
- SLOPE
- STREAM DISCHARGE AREAS
- SILLS
- SUBLITTORAL
- SUBMARINE CANYONS
- SUPRALITTORAL
- SURFACE
- TRENCHES
- 0 50M ZONE

FIGURE 2-5. BIOLOGICAL INFORMATION SYSTEM CODING SHEETS (Sheet 2 of 5)

Biological information system coding sheet-continued

51—100M ZONE
101—200M ZONE
201—500M ZONE
501—1000M ZONE
1001—2000M ZONE
2001—3000M ZONE
3001—4000M ZONE
4001—6000M ZONE
6001M AND DEEPER

FEEDING HABITS–FE

DEPOSIT FEEDERS
DETRITUS FEEDERS
FEEDING EXPERIMENTS
FEEDING HABITS
FEEDING MECHANISMS
FEEDING RATES
FILTER FEEDERS
FILTERING EFFICIENCY
FOOD CHAINS
FOOD VALUE
STOMACH CONTENT ANALYSES

FISHERIES, EXPLOITATION—FX *

COMMERICIAL USES OF SEA PRODUCTS
EXPLOITATION EFFECTS
FOOD TECHNOLOGY
MEDICINAL USES OF SEA PRODUCTS
TAGGING OPERATIONS

GENETICS–GE "
GROWTH, DEVELOPMENT–GD "

BODY SIZE
EMBRYONIC DEVELOPMENT
GROWTH STUDIES
POST EMBRYONIC DEVELOPMENT

INFORMATION HANDLING–IF

CONFERENCES
DATA SOURCES
POPULAR ARTICLES
REVIEW ARTICLES
SUBJECT BIBLIOGRAPHIES

INSTRUMENTS AND **TECHNIQUES—IT**

AERIAL PHOTOGRAPHS
ANESTHETICS
BIOASSAYS
BIOLOGICAL WATER SAMPLERS
BOTTOM SAMPLERS
CHEMICAL ANALYSES OF SEA WATER
CHROMATOGRAPHIC ANALYSES
CHROMATIC ANALYSES
CONTINUOUS PLANKTON RECORDERS
DREDGES
FILTERING RATE
GEAR SELECTIVITY
GRABS
HANDLING OF LIVE SPECIMENS
KILLING TECHNIQUES
LABORATORY APPARATUSES *

LABORATORY TECHNIQUES *
MEASURING TECHNIQUES
MOLECULAR FILTERS
NEKTON SAMPLERS
ORGANISM SEPARATING DEVICES
PARTICLE COUNTERS
PARTICLE FILTERS
PHOTOGRAPHS OF SAMPLING EQUIPMENT
PHOTOMICROGRAPHY
PLANKTON SAMPLERS
POISONS
PRESERVATION METHODS
PUMPS
RADIATION FILTERS
SAMPLING EFFICIENCY
SAMPLING TECHNIQUES
SAMPLING TECHNIQUES STANDARDIZATION
SEINES
SIGHTINGS
STAINING METHODS
TRAPS
TRAWLS

MICROBIOLOGY—MI

AEROBIC CONDITIONS
ANAEROBIC CONDITIONS
ANTIBIOTIC PROPERTY
AUTOTROPHY
BACTERIOPHAGES
BIOCIDAL ACTIVITY
BLUE GREEN ALGAE
FUNGI
GRAM NEGATIVE BACTERIA
GRAM POSITIVE BACTERIA
HETEROTROPHY
ISOLATION TECHNIQUES
MARINE BACTERIA
NUTRITIONAL REQUIREMENTS
TERRESTRIAL BACTERIA
VIRUSES
YEASTS

MIGRATIONS—MG

ANADROMOUS MIGRATIONS
CATADROMOUS MIGRATIONS
DIURNAL MIGRATIONS
HORIZONTAL MIGRATIONS
SEASONAL MIGRATIONS
VERTICAL MIGRATIONS

MORTALITY—MO

MASS MORTALITIES
STARVATION
STRANDINGS
SURVIVAL VALUE

NOXIOUS **ORGANISMS—NX**

AGGRESSIVE ORGANISMS
HUMAN PATHOGENESIS
POISONOUS FISHES
POISONOUS INVERTEBRATES

POISONOUS MAMMALS
POISONOUS PLANTS
PREVENTION OF CONTACT
THERAPEUTIC TECHNIQUES
VENOMOUS CNIDARIANS
VENOMOUS FISHES
VENOMOUS MOLLUSKS
VENOMOUS REPTILES
OTHER VENOMOUS INVERTEBRATES

ORGANISM RELATIONSHIPS–OR

COMMENSALISM
COMPETITION
CROWDING
EPIPHYTES
EPIZOA
MUTUALISM
PARASITISM
PREDATION

PATHOGENESIS—PA *

PHYSICAL OCEANOGRAPHY–PO

CATACLYSMS
CIRCULATION
COASTAL CURRENTS
CONVERGENCE
CURRENTS
DIVERGENCE
DOWNWELLING
FRONTS
HALOCLINE
MIXED LAYER
OCEANIC CURRENTS
PYCNOCLINE
STRATIFICATION
SUBSURFACE CURRENTS
THERMOCLINE
TIDAL CURRENTS
TIDES
TURBIDITY CURRENTS
TURBULENCE
UPWELLING
WATER MASSES
WAVES
WINDROWS

PHYSIOLOGY, **ANATOMY—PH ***

ANATOMY
METABOLIC STUDIES
PHYSIOLOGY
PHYSIOLOGICAL RHYTHMS
PHYSIOLOGICAL TOLERANCE

PLANKTON—PK

DIATOM BLOOMS
DINOFLAGELLATE BLOOMS
MACROPLANKTON
NANNOPLANKTON
PHYTOPLANKTON
PHYTOPLANKTON BIOMASS
PHYTOPLANKTON BLOOMS

FIGURE 2-5, BIOLOGICAL INFORMATION SYSTEM CODING SHEETS (Sheet 3 of 5)

Biological information system coding sheet--continued

PHYTOPLANKTON POPULATION DENSITY
PLANKTON MEASUREMENTS
SEDIMENTATION RATE
TSP DIAGRAMS
ULTRAPLANKTON
ZOOPLANKTON
ZOOPLANKTON BIOMASS
ZOOPLANKTON BLOOMS
ZOOPLANKTON POPULATION DENSITY

POLLUTION—PL

BOD
INDUSTRIAL WASTES
MAN-MADE POLLUTION
NATURAL POLLUTION
POLLUTION CONTROL
SEWAGE
TOXIC BLOOMS
TOXICITY
WASTE TREATMENT
WATER QUALITY

POPULATION DISTRIBUTION—PD

AGGREGATIONS
BENTHIC BIOMASS
BENTHIC POPULATION DENSITY
BENTHOS
COLONIZATION
COMMUNITY COMPOSITION
DISPERSAL
DIURNAL DISTRIBUTION
DIURNAL VARIATIONS
DOMINANT SPECIES
FACTORS CONTROLLING DISTRIBUTION
GEOGRAPHICAL DISTRIBUTION
INDICATOR SPECIES
INFORMATION THEORY
LIFE CYCLES
LIFE EXPECTANCY
MATHEMATICAL DESCRIPTIONS
MEIOBENTHOS
MICROBIAL BIOMASS
MICROBIAL POPULATION DENSITY
MICRO DISTRIBUTION
NEKTONIC BIOMASS
NEKTONIC POPULATION DENSITY
NEUSTON
PATCHINESS
PLEUSTON
POPULATION ISOLATION
POPULATION STABILITY
REPLACEMENT RATES
SAMPLING FOR CENSUSES-SURVEYS
SCHOOLS
SEASONAL DISTRIBUTION
SEASONAL VARIATIONS
SPATIAL DISTRIBUTION
SPECIES AFFINITIES
SPECIES VARIETY STUDIES
VERTICAL DISTRIBUTION
XYZ

ZONATION

PRODUCTIVITY—PR

CARBON 14 METHOD
CARBON CHLOROPHYLL RATIO
DAILY GROSS PRODUCTION
ILLUMINATION TECHNIQUES
LIGHT-PS
NON-STANDARD PRODUCTIVITY
NUTRIENT DEPLETION METHOD
OXYGEN METHOD
pH METHOD
PHOTOSYNTHETIC PERIODICITY
PHOTOSYNTHETIC RATES
PIGMENT CONCENTRATIONS
PIGMENT DISTRIBUTION
PIGMENT METHOD
PS-R

RADIATION BIOLOGY—RA

RADIOISOTOPES—RI

RADIOISOTOPE LABELING
RADIOISOTOPE TAGGING
RADIOISOTOPE UPTAKE

REPRODUCTION BIOLOGY—RE

RESEARCH PLATFORMS—RP

SONIC PHENOMENA—SP

DEEP SCATTERING LAYERS
SOUND SCATTERING

STATISTICS, COMPUTATIONS—ST

CHI SQUARE TESTS
COMPUTER ANALYSES
QUALITY CONTROL
SAMPLING DISTRIBUTION
STATISTICAL ANALYSES
TABLES FOR REDUCTION AND COMPUTATION

TAXONOMY—TX

CHECKLISTS
COLOR PATTERNS
FIELD IDENTIFICATION
NOMENCLATURE
POLYMORPHISM
RACE STUDIES
SEROLOGICAL TAXONOMY
TAXONOMIC DESCRIPTIONS
TAXONOMIC KEYS

UNDERWATER OPERATIONS—UN

BOTTOM MOVIES
BOTTOM PHOTOGRAPHS
OBSERVATIONS BY DIVERS
OBSERVATIONS BY TV
OBSERVATIONS FROM SURFACE SHIP
REMOTELY CONTROLLED MANIPULATORS
UNDERWATER MOVIES
UNDERWATER PHOTOGRAPHS
UNDERWATER OPERATIONS

ADDITIONAL TERMS

4

FIGURE 2-5. BIOLOGICAL INFORMATION SYSTEM CODING SHEETS (Sheet 4 of 5)

Biological information system coding sheet-continued

TAXA

o CHLOROPHYCEAE
O XANTHOPHYCEAE
o CHRYSOPHYCEAE
0 COCCOLITHOPHORIDACEAE
O BACILLARIOPHYCEAE
0 CENTRALES
0 PENNALES
O CRYPTOPHYCEAE
0 DINOPHYCEAE
o DINOFLAGELLATA
o PHAEOPHYCEAE
O RHODOPHYCEAE
O MYXOPHYCEAE
O MYXOMYCETES
o SCHIZOMYCETES
O PHYCOMYCETES
O ASCOMYCETES
O BASIDIOMYCETES
O DEUTEROMYCETES
O BRYOPHYTA
O PTERIODOPHYTA
0 SPERMATOPHYTE

PROTOZOA
0 MASTIGOPHORA
o SARCODINA
o RADIOLARIA
o FORAMINIFERA
o OTHER SARCODINA
o SPOROZOA
o CILIATA
0 PORIFERA
o MESOZOA
CNIDARIA
0 HYDROZOA
o SCYPHOZOA
o ANTHOZOA
O CTENOPHORA
PLATYHELMINTHES
O TURBELLARIA
0 TREMATODA
0 CESTODA
0 ROTIFERA
O NEMATODA
o NEMERTINA
0 GASTROTRICHA
O KINORHYNCHA
O PRIAPULIDA
0 NEMATOMORPHA
0 ACANTHOCEPHALA

BRYOZOA
O ECTOPROCTA
o ENTOPROCTA
O PHORONIDA
o BRACHIOPODA
MOLLUSCA
O AMPHINEURA
0 MONOPLACOPHORA
O PROSOBRANCHIATA
OPISTHOBRANCHIATA
0 TECTIBRANCHIA
o PTEROPODA
0 NUDIBRANCHIA
O PULMONATA
O SCAPHOPODA
0 PELECYPODA
0 CEPHALOPODA
0 POLYCHAETA
O MYZOSTOMARIA
o OLIGOCHAETA
O HIRUDINEA
O ARCHIANNELIDA
o ECHIUROIDEA
O SIPUNCULOIDEA
0 GEPHYREA
ARTHROPODA
o PYCNOGONIDA
0 PENTASTOMIDA
0 TARDIGRADA
o BRANCHIOPODA
0 OSTRACODA
o COPEPODA
o CALANOIDA
o MONSTRILLOIDA
0 CYCLOPOIDA
0 HARPACTICOIDA
0 NOTODELPHYOIDA
0 CALIGOIDA
0 LERNAEOPODOIDA
0 MYSTACOCARIDA
o BRANCHIURA
0 CIRRIPEDIA
MALACOSTRACA
0 NEBALIACEA
0 ANASPIDACEA
O MYSIDACEA
O CUMACEA
o TANAIDACEA
o GNATHIIDEA
0 ISOPODA
0 AMPHIPODA
O STOMATOPODA
O EUPHAUSIACEA
0 DECAPODA

O CHAETOGNATHA
O POGONOPHORA
ECHINODERMATA
O CRINOIDEA
0 ASTEROIDEA
o OPHIUROIDEA
0 ECHINOIDEA
0 HOLOTHUROIDEA
CHORDATA
0 HEMICHORDATA
0 UROCHORDATA
o ASCIDIACEA
0 THALIACEA
O LARVACEA
O CEPHALOCHORDATA
0 PETROMYZONTIA
o CHONDRICHTHYES
0 OSTEICHTHYES
O CHELONIA
O SQUAMATA
O CROCODILIA
O AVES
O URSIDAE
0 MUSTELIDAE
0 OTARIIDAE
o PHOCIDAE
O ODOBAENIDAE
0 ODONTOCETI
0 MYSTICETI
0 SIRENIA

FIGURE 2-5, BIOLOGICAL INFORMATION SYSTEM CODING SHEETS (Sheet 5 of 5)

SD File Description

(a) Short Title—SD2CR/SD2GE
(b) Full **Tide-Stafim** Data Cruisc File/Staticrn Data Geographic File
(c) Data Period— 1893 to present
(d) Depth Range— O–1 1,999 **meters**
(e) Sorting Sequence—SD2CR: Country, **NODC** reference identity number, NODC consecutive number, continuation number.
SD2GE: Ocean area, Canadian 10-degree square, 1-degree square, month, year, country, **NODC reference identity number,** NODC consecutive number, continuation number.
(f) Tape Label—Standard label
(g) Record Length-4, 164 bytes (maximum)
(h) Record Type—Variable blocked
(i) Blocking Factor—Not applicable
(j) Blocked Length—5,300 bytes (maximum)
(k) Density—l ,600 BPI
(1) Mode—EBCDIC
(m) Tracks—9
(n) Parity—Odd
(o) Present Volume—504,000 stations. 24/32 reels
(P) Expected Annual Growth Rate—35,000 **stations**

SD Record Description

FILE NAME: STATION DATA II **RECORD NAME: MASTER INFORMATION**

ELEMENT NAME AND LEVEL	LOCATION Position	LOCATION Units	LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES TYPE BASE MODE LANGUAGE PRECISION ETC	USAGE AND MEANING OF ELEMENT	CONDITIONS
CONTIN #	1	Byte				Char(1)	Non-zero ind. multi-ret. station	Continuation indicator
CNTRY #*	2	Byte				Char(3)	Alphanumeric bxx	Originator's nationality
CRUISE #*	5	Byte				Char(S)	Prefix 'S'	NODC reference number
CONSEC # *	10	Byte				Char(4)		NODC consecutive number
RECID •	14	Byte				Char(2)	19 for Nansen Cast, 62 for STD	Record identification
AREACD #*	16	Byte				Char(2)	01-10, assigned by NODC	Ocean area
TENSQ #*	18	Byte				Char(4)	0-1735, starts at 20" E long.	Canadian 10-degree square
ONESQ #*	22	Byte				Char(2)	00-99, Canadian system	one-degree square
TWOSQ •	24	Byte				Char(2)	0-88 by 2's, Canadian	Two-degree square
FIVESQ •	26	Byte				Char(1)	1-4, Canadian	Five-degree square
LATHEM *	27	Byte				Char(l)	Nor S	Hemisphere of l at itude
LATDEG •	28	Byte				Char(2)	0.90	Degrees latitude
LATMIN •	30	Byte				Char(2)	0-60, blank	Minutes latitude
LTMNTN •	32	Byte				Char(1)	D-9, blank	Minutes latitude, tenths
LONHEM '	33	Byte				Char(1)	W or E	Hemisphere of longitude
LONDEG •	34	Byte				Char(3)	0-180 if 180 long. min=0, or blank	Degrees lbongitude
LONMIN •	37	Byte				Char(2)	0-60, blank	Minutes latitude
LNMNTH *	39	Byte				Char(1)	O-9, blank	Minutes latitude, tenths
QUARTR	40	Byte				Char(1)	1, 2, 3, 4 or 9	Quarter-degree square
YEAR #*	41	Byte				Char(2)	00-present, blank	Year
MONTH #*	43	Byte				Char(2)	1-12	Month of year, GMT
DAY *	45	Byte				Char(2)	1-31, blank	Day of month, GMT
STIME	47	Byte				Char(3)	Blank 000-99.9, blank	Station time, GMT hours
SHIP •	50	Byte				Char(6)	Alphanumeric, left justified	Ship, to be unique numeric code
DBOT •	S6	Byte				Char(5)	0-11,999 or blank	Depth to bottom, meters
DEPEFF *	61	Byte				Char(4)	Depth of deepest sound velocity†	Effective depth, meters
DURCST	65	Byte				Char(3)	From 3rd obs. record for STD data only	Cast duration, hours

• Indicates field is in I rameter Inventory
Sort Field
† Or deepest observed de| with valid density, temperature, and salinity

FIGURE 2-6. OCEANOGRAPHIC STATION DATA FILE FORMAT (Sheet 1 of 4)

SD Record Description--continued

FILE NAME: ST. ION DATA II | RECORD NAME: MASTER INFORMATION [continued]

ELEMENT NAME AND LEVEL			LENGTH Number	Units	REPEAT FACTOR	ATTRIBUTES TYPE BASE MODE LANGUAGE PRECISION ETC	USAGE AND MEANING OF ELEMENT	CONDITIONS
TRACED		6B	Byte			Char(1)	U, O, A, or blank	Trace direction
QUAL	•	69	Byte			Char(l)	O-9, blank at creation time	Quality indicator
DUC	`	70	Byte			Char[l)	1-5, blank	Data use code
MNDPTH	`	71	Byte			Char(4)	1st ohs. depth w/valid d, T, & S	
MXDPTH	`	75	8yt e			Char (4)	Deepest valid ohs. parameter	Maximum depth, meters
NXTRC1		79	Byte			Char(l)	Always 2	Next record indicator
REC 1		80	Byte			Char(l)	Always 1	Record indicator
DFDPTH	•	81	Byte			Char (4]	DBOT-MXDPTH, minus or blank	Dif ference depth, meters
VERTSP	`	8s	Byte			Char(2)	00-99, blank	Vertical sample spacing
SALPCT	•	87	Byte			Char(I)	o-9 or -	Percent salinity present **
OXPCT	•	88	8yt e			Char(1)	0-9 or -	Percent oxygen present • +
P04 PCT	•	89	Byte			Char(1)	0-9 or -	Percent inorganic P04 present • +
TOTPCT	•	90	Byte			Char(1)	0-9 or -	Percent total phosphorus • *
STOPCT	•	91	Byte			Char(1)	0.9 or -	Percent silicates present • *
NO2PCT	`	92	8yte			Char(1)	0-9 or -	Percent nitrites present • *
N03PCT	•	93	Byte			Char(1)	0-9 or -	Percent nitrates present • *
PHPCT	•	94	Byte			Char(1)	0-9 or -	Percent pH present • *
ORGCRS		9s	Byte			Char (3)	Alphanumeric	Originator's cruise
ORGSTA		98	Byte			Char(9)	Alphanumeric, left justified	Originator's station
COLOR	•	107	8yte			Char(2)	00-21, blank	Water color, Forel-ule code
TRANS	•	109	Byte			Char(2)	00-99, blank, Secchi disk	Water transparency, meters
WAVDIR		111	Byte			Char(2)	00-36, 49, SO-56, 99, blank	Wave direction, WMO Code 0885
HEIGHT		113	Byte			Char(1)	O-9, x, blank if SEA STATE pres.	Wave height, WMO Code 1555
SEASTA		114	Byte			Char(1)	blank if HEIGHT present	Sea state, WMO Code 3700
FORCE		115	Byte			Char(2)	Blank if SPEED present	Wind force, Beau fort Code
FILL2		117	Byte			Char(1)	Only used for updating file	Sorting control information
ERIOD		118	Byte			Char(1)	O-9, x. blank if sea state pre.	ave period. WMO Code 315S
INDIR		119	Byte			Char(2)	Tens of degrees or blank	ind direction, WMO Code 877
PEED		121	Byte			Char(2)	Blank if wind force present	ind speed, knots
ARON		123	Byte			Char(5)	09450-10449, blank	arometric pressure, millibars
RY		128	Byte			Char (4)	bxx. x, bxx.b or blank	ry bulb temperature, Celsius
RYIN		132	Byte			Char(l)	O, 1, 0r9	w bulb indicator, precision
ET		133	Byte			Char(4)	bxx. x, bxx. b or blank	et bulb temperature, Celsius
ETIN		137	Byte			Char(l)	O, 1, or 9	et bulb indicator, precision
EATHR		138	Byte			Char(2)	WMO Code 4501 is single digit	MO Code 4501 or WMO Code 4677
YPE		140	Eyte			Char(1)	O-9, blank	loud type, WNO Code 0500
MOUNT		141	Byte			Char(1)	0-9, blank	loud amount , WMO Code 2700
UMOBS	•	142	Byte			Char(3)	000-999	umber of observed depth
UMSTN		14s	Byte			Char(2)	00-34	umber of standard depths
UMDET		147	8yte			Char(3)	000-999	umber of detail depths
ILL9		150	Byte			Char [9)	Blank for word al ignment	ot used
XTRC2		159	Byte			Char(1)	1 ,3,4,6,7	ext record indicator
EC2		160	Byte			Char(1)	Always 2	ecord indicator

'1 icates fi(I ir arameter Inventory

** Percent of observed containing salinity oxygen, and other values

FIGURE 2-6, OCEANOGRAPHIC STATION DATA FILE FORMAT (Sheet 2 of 4)

SD Record Description—continued

ILE NAME: ST "ION DAT RECORD NAME: OBSERVED DEPTH INFORMATION

ELEMENT NAME AND LEVEL	LOCATION Position	LOCATION Units	LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES TYPE, BASE, MODE LANGUAGE, PRECISION, ETC	USAGE AND MEANING OF ELEMENT	CONDITIONS
DEPOBS	1	byte				Char(5)	00(?00-12000	Depth , meters
DEPIN	6	Byte				Char(1)	6, 7, 8 numeric cond. code or blank	Depth quality indicator
THERM	7	Byte				Char(1)	T for thermometric depth blank	Thermometric depth
TMPOBS	8	Byte				Char(S)	-4.0bb to 4S,000	Temperature, Celsius
TEMPRC	13	Byte				Char(1)	1, 2, 3 or 9	Temperature , precision
TEMPIN	14	Byte				Char(1)	7, 8 or condition, blank	Temperature quality indicator
SALOBS	1s	Byte				Char(S)	0.0bb - 4S.000	Salinity, parts /thousand
SALPR	2(I	Byte				Char(1)	1, 2, 3 or 9	Salinity precision
SALIN	21	Byte				Char(1)	7, B or condition, blank	Salinity quality indicator
SIGMAT	22	Byte				Char(4)	-4,00 to 4S .00, blank	Sea water density, (G/L)
SIGIND	26	Byte				Char(1)	8, 9 numeric cond. code or blank	Sigma-t quality indicator
SNDVEL	27	Byte				Char(S)	1300.0 - 1600.0	Sound velocity, meters/sec.
SNDPR	32	Byte				Char(1)	I o r 9	Sound velocity precision
OXYOBS	33	Byte				Char(4)	00. 0b-14 ,00, blank	Oxygen, milliliters/liter
OXYPR	37	Byte				Char(1)	1, 2 or 9	Oxygen precision
OXYIND	38	Byte				Char(1)	8 or blank	Oxygen quality indicator
BLANK6	39	Byte				Char(6)	Blank for word alignment	Blank
MTIME	4S	Byte				Char(3)	00. b to 99.9, blank	Release time of messenger hours
CASTNO	48	Byte				Char(l)	0-9	Cast number
PHOSP	49	Bytc				Char [4)	x x. x x, blank or bx.xx	Inorganic phosphate
PHOSPR	53	Byte				Char(l)	1, 2, 4, S or 9	Inorganic phosphate precision
TOTPHP	54	Byte				Char [4)	blank or bx.xx	Total phosphorus
TPHS IN	58	Byte				Char(l)	1, 2,4, 5, or 9	Total phosphorus precision
S103	59	Byte				Char(4)	blank or xxx. b	Silicates
S IO3PR	63	Byte				Char(l)	o, 1,4, 5, or 9	Silicates precision
NO2	64	Byte				Char(3)	blank or x.xx	Nitrites
NO2PR	67	Byte				Char(l)	1, 2,4, 5, or 9	Nitrites precision
:O3	68	yte				bar(3)	blank or xx . x	Nitrates
:O3PR	71	yte				bar(I)	, 1, 4, S, or 9	Nitrate precision
'H	72	yte				bar(3)	blank or x.xx	PH
'HPR	7S	yte				bar(I)	, 2 , 4 , 5, or 9	PH indicator
							irst 5 chemistry fie Ids in units	f microgram-atoms per liter
'BSF LG	76	yte				har(3)	rom EDIT Program	tatus Report bits
	4	Bit					hosphate GT 4.00	
	S	Bit					otalPhosphorus LT Phosphate	
	6	Bit					ilicate-Silicon CT 300,	
	7	Bit					itrite-Nitrogen GT 4.00	
	B	Bit					itrate-Nitrogen GT 45.0	
	9	Bit					H LT 7.40 or GT 8,s0	
	19	Bit					igma-t decreases by more than 0	
XTOBS	79	yte				bar(l)	, 3, 4, 6 or 7	ext record type
BSTYP	80	yte				bar(l)	or 5	ecord type

Pre sion idic ors ont n ei er the number c digits right of the decimal poi or 9 for a blank field.

FIGURE 2-6. OCEANOGRAPHIC STATION DATA FILE FORMAT (Sheet 3 of 4)

SD Record Description—continued

FILE NAME: STATION DATA II

ORD NAME: STANDARD DEPTH FORMATION

ELEMENT NAME AND LEVEL	LOCATION Po	LOCATION Units	LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES TYPE BASE MODE LANGUAGE PRECISION ETC	USAGE AND MEANING OF ELEMENT	CONDITIONS
SDEPTH	1	yte				Char(5)	1000.12000	Depth, meters
SDF. PIN	6	yte				Char(1)	ank only	Oepth quality
PAD	7	yte				Char(1)	ank for word alignment	Sot used
STEMP	8	yte				Char(4)	.00 to 44.00, blank	Temperature, Celsius
PAD .	12	yte				Char(1)	ank for word al ignment	Not used
STEMPR	13	yte				Char (1)	or 9	Temperature precis ion
PAD	14	yte				Char(1)	ank for word alignment	Not used
SSALIN	15	yte				Char [4)	).00 to 45.00, blank	Salinity, parts/thousand
PAD	19	yte				Char(1)	ank for word al ignment	Not used
SSLPR	20	yte				Char(1)	or 9	Salinity precision
PAD	21	yte				Char(1)	ank for word alignment	Not used
SSIGT	22	yte				Char(4)	1.00 -4 S.00, blank	Sea water density (G/L)
SSIGIN	26	yte				Char(1)	or blank	Sigma-t quality indicator
SSVEL	27	yte				Char(S)	500.0-1600 .0, blank	Sound velocity, meters/second
SNDPR	32	yte				Char(1)	or 9	Sound velocity precision
SOXY	33	yte				Char(4)	).00-14.00, blank	Oxygen, milliliters/liter
SOXYPR	37	yte				Char(1)	or 9	Oxygen precision
PAD	38	yte				Char(1)	ank	Not used
SDYD	39	yte				Char(S)	! .000-4.000, blank	Dynamic depth anomaly
SDYDPR	44	yte				Char(1)	or 9	Dynamic depth anomaly precis.
PADS	45	yte				Char(31)	ank for word alignment	Not used
STNFLG	76	yte				Char(3)	rom EDIT program	Status report bits
	19	it				Bit(1)	gma-t decreases by more than ().02	
NXTSTN	?9	yte				Char(1)	, 4, 6 or 7	Next record indicator
STNTYP	80	yte				Char(l]	or 7	Standard record type

FIGURE 2-6, OCEANOGRAPHIC STATION DATA FILE FORMAT
(Sheet 4 of 4)

MBT Data File Description

(a) Short Title—BTCRU/BTGEO
(b) Full Title—BT Cruise File/BT Geographic File
(c) Data Period—1941 to present
(d) Depth Range—0 to 285 meters
(e) Sorting Sequence—BTCRU: NODC reference identity number, NODC consecutive number. BTGEO: Marsden square, 1-degree square, month, latitude, longitude, year, day, time
(f) Tape Label—Standard
(g) Record Length—324 bytes
(h) Record Type—Variable blocked
(i) Blocking Factor—Not applicable
(j) Block Length—3,520 bytes
(k) Density—1,600 BPI
(l) Mode-Packed decimal and EBCDIC
(m) Tracks—9
(n) Parity-Odd

FIGURE 2-7. MECHANICAL BATHYTHERMOGRAPH DATA FILE FORMAT (Sheet 1 of 2)

MBT Record Description

: NAME: PACKED DECIMAL BT FILE RECORD NAME:

ELEMENT NAME AND LEVEL	LOCATION		LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES, TYPE, BASE, MODE, LANGUAGE, PRECISION, ETC.	USAGE AND MEANING OF ELEMENT	CONDITIONS
	1-2	Byte	2	Byte		Fixed Dec. (3)	Always 106	
	3	Byte	1	Byte		Fixed Dec. (1)	Zero on All Records	
	4-s	Byte	2			Fixed Dec. (2)	99 = Blank on All Records	
	6-7	Byte	2	Byte		Fixed Dec. (3)	Marsden Square	
	8	Byte	1	Byte		Fixed Dec. (1)	Five Degree Square	
	9.10	Byte	2	Byte		Fixed Dec. (2)	One Degree Square	
	11-12	Byte	2	Byte		Fixed Dec. (2)	Month	
	13-15	Byte	3	Byte		Fixed Dec. (5)	NCIDC Reference Identity Number	
	16-18	Byte	3	Byte		Fixed Dec. (4)	NODC Consecutive Print Number	
	19	Byte	1	Byte		Fixed Dec. (1)	Zero on All Records	
	20-22	Byte	3	Byte		Char(3)	Country Code - Left Adjusted	
	23-25	Byte	3	Byte		Char(3)	Institution Code - Left Adjusted	
	26-31	Byte	6	Byte		Char(6)	Ship Number - Left Adjusted	
	32-33	Byte	2	Byte		Char(2)	Ocean Weather Station (OWS) - Le.. Adjusted	
	34	Byte	1	Byte		Fixed Dec. (1)	NODC Quality Code	9 = "Blank
	35-36	Byte	2	Byte		Fixed Oec. (3)	Precision Codes for Latitude, Longitude and Time	
	37-39	Byte	3	Byte		Fixed Dec. (4)	Latitude in Degrees and Minutes	
	40-42	Byte	3	Byte		Fixed Dec. [S)	Longitude in Degrees and Minutes	
	43-44	Byte	2	Byte		Fixed Dec. (3)	Year	
	45-46	Byte	2	Byte		Fixed Dec. [2)	Day of Month	99 = Blank
	47-49	Byte	3	Byte		Fixed Dec. (4)	Time in Hours and Minutes	9999 = Blank
	50-52	Byte	3	Byte		Fixed Dec. (S)	Depth of Trace	
	53	Byte	1	Byte		Fixed Dec. (1)	Depth Code	9 = Blank
	54	Byte	1	Byte		Char(1)	Control for Temperature Correct i	
	55-56	Byte	2	Byte		Fixed Dec. (2)	Instrument Type	
	57-58	Byte	2	Byte		Fixed Dec. (2)	Input Units Code	
	59-60	Byte	2	Byte		Fixed Dec. (2, 1)	Temperature Correct ion	,9 = Blank
	61-6	Byte	2	Byte		Fixed Dec. (2)	Depth Correction	9 = Blank
	6.	Byte	1	Byte		Fixed Dec. (1)	Reference Temperature Type	= Blank
	64-6'	Byte	2	Byte		Fixed Dec. (3, 1)	Reference Temperature	9.9 = Blank
	66-7	Byte	8	Byte		Char(B)	Originator's Cruise Number	
	74-7	Byte	4	Byte		Char (4)	Originator's Slide Number	
	7	Byte	1	Byte		Fixed Dec. (1)	Detail Data Type Code O = Normal Will Always Be Code O	= Card Type 50
	79-8	Byte	2	Byte		Fixed Dec. [2)	Length of Ship's Name - 26 on Al	ecords
	81-10	Byte	26	Byte		Char(26)	Ship Name	
	107-10	Byte	2	Byte		Fixed Dec. (3)	Depth of First Temperature	
	109-11	Byte	2	Byte		Fixed Dec. (3)	Interval Between Depths	
	111-11	Byte	2	Byte		Fixed Dec. (3)	Number of Depths	ax = 100
	11	Byte	2	Byte	*	Fixed Dec. (3, 1)	Array of Temperatures ("C]	

* Re at f or dic ed val in positions .112

FIGURE 2-7. MECHANICAL BATHYTHERMOGRAPH DATA FILE FORMAT (Sheet 2 of)

- Expendable Bathythermograph Data File Format (Figure Z-8)
- HI-9 Surface Current Data File Format (Figure 2-9)
- Netherlands 193 Surface Current Data File Format (Figure 2-10)
- Drift Bottle and Seabed Drifter File Format (Figure 2-11)

2.6 MESA Tape Formats

Recognizing that the standard NODC files were not sufficient to accommodate all sampled oceanographic data, NODC and the NOAA MESA Project established several new data tape formats to be used by the MESA New York Blight study. These formats are being used on a experimental basis and are expected to be formally adopted and in general use well before the end of calander year 1975.

MESA tape formats are presented in the following

- Metals in Organisms, Sediment and Water (Table 2-1)
- Surficial Sediment Characteristics (Table 2-2)
- Water Physics and Chemistry (Table 2-3)
- Benthic Marcofauna (Table 2-4)

XBT Data File Description

(a) **Short** Title—XBCRU/XBGEO

(b) Full Title—Expendable Bathythermograph Cruise/Geographic Data File

(c) Data Period—1 962 to present

(d) Depth Range—O to 1,830 meters

(e) Sorting Sequence—XBCRU: NODC reference identity number, NODC consecutive number. XBGEO: WMO quadrant of the globe, WMO 10-degree square, 5-degree square, 2-degree square, 1-degree square, month

(f) Tape Label—Standard

(g) Record Length—1304 bytes (maximum)

(h) Record Type—Variable

(i) Blocking Factor—1

(j) Block Length—1 308 bytes (maximum)

(k) Density—1 ,600 BPI

(1) Mode—EBCDIC

(m) Tracks—9

(n) Parity—Odd

FIGURE 2-8. EXPENDABLE BATHYTHERMOGRAPH DATA FILE FORMAT (Sheet 1 of 2)

XBT Record Description

ILE NAME: XBT RECORD NAME: XBT 9-TRACK TAPE RECORD

ELEMENT NAME AND LEVEL	LOCATION Position	LOCATION Units	LENGTH Number	LENGTH Units	REPEAT FACTOR	ATTRIBUTES TYPE, BASE MODE, LANGUAGE, PRECISION, ETC.	USAGE AND MEANING OF ELEMENT	CONDITIONS
FILE ID	1	Byte	2	Byte		Char(2)	File I.D.	OOC Deck No. 17
QUADRT	3	Byte	1	Byte		Char(1)	WMO 3333	.7
TEN SQ	4-6	Byte	3	Byte		Char(3)	Ten Degree Square (WMO)	00-918 Use with Quad.
FIVE SQ	7	Byte	1	Byte		Char(1)	Five Degree Square	-4
TWO SQ	B-9	Byte	2	Byte		Char(2)	Two Degree Square	0-88
ONE SQ	10-11	Byte	2	Byte		Char(2)	One Degree Square	o-99
DATE								
YEAR	12-15	Byte	4	Byte		Char (4)	Prefix '19'	5 (GMT)
MONTH	16-17	Byte	2	Byte		Char(2)	01-12	
DAY	18-19	Byte	2	Byte		Char(2)	01-31	
TIME								
HOUR	20-21	Byte	2	Byte		Char(2)	00-23	
MIN	22-23	Byte	2	Byte		Char(2)	00-s9	
REF ID								
CNTRY	24-26	Byte	3	Byte		Char(3)	NODC	DEs
REF NO	27-31	Byte	S	Byte		Char(5)		
CONSEC	32-34	Byte	3	Byte		Char(3)		
SHIP	3s-40	Byte	6	Byte		Char(6)		
LATITUDE								
LAT DEG	41-42	Byte	2	Byte		Char(2)	00-90	
LAT MIN	43-44	Byte	2	Byte		Char(2)	00-s9	
LAT HEM	4s	Byte	1	Byte		Char(1)	Nor S	
LONGITUDE								
LONG DEG	46-48	Byte	3	Byte		Char(3)	000-179	
LONG M IN	49-so	Byte	2	Byte		Char(2)	00-s9	
LONG HEM	51	Byte	1	Byte		Char(1)	E or W	
NODC CODES								
BOTTOM	52	Byte	1	Byte		Char(1)	B = Probe hit bottom, b . did no	or blank
DIGMTH	53	Byte	2	Byte		Char(2)	Method of digitization	,-99 NODC codes
INTER	55	Byte	2	Byte		Char(2)	Interval of digitization	.-99
TRESTO	S7	Byte	2	Byte		Char(2)	Method of treatment + storage of	itial points
OPERATOR								
INIT	59	Byte	3	Byte		Char(3)	operator's initials	
TRIAL	62	Byte	1	Byte		Char(1)	Number of attempts at digitizing	ace
CALDEP	63	Byte	3	Byte		Char(3)	Depth at Cal i brat ion Tick in Uni	of the analog grid
CALTEM	66	Byte	3	Byte		Char(3)	Temperature at Calibration Tick	Units of the analog grid
INSTRUMENT	69	Byte	1	Byte		Char(1)	1 = XBT, 2 = HXBT, 3 = SXBT, 4 o	BT
GRID 3/	70	Byte	1	Byte		Char[1]	Grid Codes of the Instrument	-9
ORIG CR NO	71	Byte	8	Byte		Char(B)	Originator's Cruise Number	lphanumeric
DNP	79	Byte	1	Byte		Char(1)	Declared National Program	.4
SKIP	80	Byte	1	Byte		Char(1)	Blank For byt	oundary alignment
LENGTH	81	Byte	2	Byte		FIXED Binary	(16) Number of Temperature Value	
DEPTH 6 TEMP ("C)								
SURTEM	B3	Byte	2	Byte		FIXED Binary (16	Temperature at zero depth to hun	dths (1/100 insignificant)
DEPTH	85	Byte	2	Byte		"	First Depth to whole meters	
TEMP (1)	87	Byte	2	Byte		"	Temperature at First Depth	
DEPTH (2)	89	Byte	2	Byte		"	Second Depth	
TEMP (2)	91	Byte	2	Byte		"	Temperature at Second Depth	
DEPTH (N)		Byte	2	Byte		"	Last Depth Position = 4 . (N-1) + 83	
TEMP (N)		Byte	2	Byte		"	Last Temperature Position = 4 • (N-1) + 8S	
							Average Record Length = 4 • (N-1) + 85 N = 4 0	241 bytes

FIGURE 2-8, EXPENDABLE BATHYTHERMOGRAPH DATA FILE FORMAT (Sheet 2 of 2)

HI-9 Surface Current Data File Description

(a) Short Title—H1-9
(b) Full TMe-Surface Current Data
(c) Data Period—1904-45
(d) Depth Range—Not applicable
(e) Sorting Sequence—Marsden square, l-degree square, month, year, day, hour
(f) Tape LabelStandard
(g) Record Length-80 bytes
(h) Record Tape-Fixed block
(i) Blocking Factor—20
(j) Block Length-l ,600 bytes
(k) Density-1,600 BPI
(1) Mode—EBCDIC
(m) Tracks-9
(n) Parity-Odd

FIGURE 2-9. H1 -9 SURFACE CURRENT DATA FILE FORMAT (Sheet 1 of 2)

HI-9 Surface Current Data Tape Record Layout

Columns	Field
1–2	YEAR
3	MO
4–5	DAY
6–7	HOUR
8	
9	FROM POSITION LAT QUAD
10–11	FROM POSITION LAT DEG
12–13	FROM POSITION LAT MIN
14–16	FROM POSITION LONG DEG
17–18	FROM POSITION LONG MIN
19	TO POSITION LAT QUAD
20–21	TO POSITION LAT DEG
22–23	TO POSITION LAT MIN
24–26	TO POSITION LONG DEG
27–28	TO POSITION LONG MIN
29–32	
33–34	MONTH
35	
36–37	INJ DEPTH
38	W DIR
39–41	MARSDEN SQ
42	C DIR
43	5 CUR
44–45	1 SQ
46–48	M SQ TO POSITION
49–50	1 SQ TO POSITION

Columns	Field
51	5 SQ TO POS
52	DIR SEA
53	DIR SW
54–59	LAT MED POS: QUAD, DEGREES, TENTH
60–66	SURFACE LONG: DEG, TEN; CURRENTS: SET IN DEGS, DRIFT 10 KNOT
67–70	WIND: DIR., FORCE
71–72	TEMP SURF INJECT
73–80	SEA CONDITIONS: DIR, TRUE, AMT; SWELL: DIR, TRUE, AMT

FIGURE 2-9. Hi-9 SURFACE CURRENT DATA FILE FORMAT (Sheet 2 of 2)

Netherlands 193 Surface Current Data File Description

(a) Short Title—Neth 193
(b) Full Title—Surface Current Data
(c) Data Period—1853-1931
(d) Depth Range-Not applicable
(e) Sorting Sequency—Marsden square, 5-degree square, 1-degree square, month, year, day
(f) Tape Label—Standard
(g) Record Length—80 bytes
(h) Record Type-Fixed block
(i) Blocking Factor—20
(j) Block Length— 1,600 bytes
(k) Density—1,600 BPI
(l) Mode—EBCDIC
(m) Tracks—9
(n) Parity—Odd

FIGURE 2-10. NETHERLANDS 193 SURFACE CURRENT DATA FILE FORMAT (Sheet 1 of 2)

Netherlands 193 Surface Current Data Tape Record Layout

Columns	Field
1–2	DAY
3	MO
4–5	YEAR
6–7	CURRENT SET
8–9	CURRENT DRIFT
10	NO
11–12	2 SQ
13	5 SQ
14–16	MARSDEN SQ
17–18	1' SQ
19	W
20	
21–22	WIND DIR
23–24	WIND FORCE
25–26	
27–29	AIR PRESS MM
30	VIS
31–32	
33–34	MONTH
35–38	
39–41	MARSDEN SQ
42	
43	5 SQ
44–45	1 SQ
46–49	
50	SEA AMT

Columns	Field
51–52	SWELL DIR
53	SWELL AMT
54–55	DUR OF FOG
56–57	DUR OF PRECIP
58–61	
62–72	TEMPERATURE C: AIR, SEA, DIFFER
73–75	UP CLOUD TYPE DIR
76	AMT
77–80	CARD TYPE

77	78	79	80
N	1	9	3

Columns 62–76: COLUMNS 32 46 OF CARD

FIGURE 2-10. NETHER LANDS 193 SURFACE CURRENT DATA FILE FORMAT (Sheet 2 of 2)

Drift Bottle and Seabed Drifter File Description

(a) Short Title-Drift Bottle
(b) Full Title-Drift Bottle and Sea Bed Drifter
(c) Data Period-1 890 to present
(d) Depth Range—Not applicable
(e) Sorting Sequency—Marsden square, l-degree square, year, month, day
(f) Tape Label—None
(g) Record Length—80 bytes
(h) Record Type—Fixed block
(i) Blocking Factor—10
(j) Block Length-80 bytes
(k) Density—556 BPI
(1) Mode—BCD
(m) Tracks—7
(n) Parity—Even

FIGURE 2-11. DRIFT BOTTLE AND SEABED DRIFTER FILE FORMAT (Sheet 1 of 2)

Drift Bottle and Seabed Drifter Tape Record Layout

RECORD-1

Columns	Field
1 2 3 4	REFERENCE NUMBER
5 6 7	CONSEC NUMBER
8 9	COUNTRY CODE
10 11	INST CODE
12	MODE
13 14 15	SHIP CODE
16 17	YEAR
18 19	MONTH
20 21	DAY
22 23	HOUR
24 25 26 27	LATITUDE ° '
28 29 30 31 32	LONGITUDE ° '
33 34 35	MARSDEN SQUARE
36	¼° SQ.
37 38	SHORE DIST
39 40	NO. RELEASED
41	TYPE
42 43 44 45 46	BOTTLE NUMBER
47 48	YEAR
49 50	MONTH

Columns	Field
51 52	DA Y
53 54 55 56	LATITUDE
57 58 59 60 61	LONGITUDE '
62	AFBE
63 64 65	BEARING
66 67 68 69	NAUTICAL MILES DRIFTED
70 71 72	DAYS ADRIFT
73 74 75	SPEED
76	CO. TYPE
77 78	
79 80	DECK NO.
81	27
82	32
83	38
84	49
85	51
86	56
87	61
88	64
89	66
90	69
91	70
92	71
93	12
94	74
95	75
96	
97 98	18/19
99 100	16/19

Columns	Field
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120	COLUMNS 96 AND 101.120 CONTAIN BLANKS
RECORD-2: 1 2 3 . . • 120	
RECORD-3: 1 2 3 • • • 120	
. . . .	
RECORD-N: 1 2 3 • • • 120	
TM	APEMARK

ZONE EDIT NUMERIC CODES FOR POSITIONS 81.95
BLANK. EDITED COLUMN CONTAINED NO ZONE PUNCHES
1. EDITED COLUMN CONTAINED AN "11" (OR "X") ZONE
2. EDITED COLUMN CONTAINED A "12" [OR "Y") ZONE
3. EDITED COLUMN CONTAINED A ZERO ZONE (NOT DIGIT O)

FIGURE 2-11. DRIFT BOTTLE AND SEABED DRIFTER FILE FORMAT (Sheet 2 of 2)

TABLE 2-1. METALS IN ORGANISMS, SEDIMENT AND WATER
(Sheet 1 of 7)

MESA Tape Format
Metals in Organisms, Sediment and Water

12/4/74

FILE HEADER

Characters*	Field Description
001	File Type (code denotes this file format)
XXXXXX	Date of file generation (year, month, day)
1	Record Type (code denotes File Header)
(up to 11 A characters)	Vessel (left adjusted)
(up to 6 A characters)	Cruise Number (left adjusted)
xx/xx/xx - xx/xx/xx	Cruise Dates (slashes and dash included)
(up to 19 A characters)	Senior Scientist (left adjusted]
(up to 42 A characters)	Investigator and Institution Responsible for Data (left adjusted)

* X = numeral, A = alphanumeric, specific characters are given

NOTE : The contents of all fields are right adjusted unless otherwise indicated.

TABLE 2-1. METALSIN ORGANISMS, SEDIMENT AND WATER
(Sheet 2 of 7)

Characters	Field Description
XXXXX	Sample Depth (to nearest tenth of meter)
XXXXX	Water Depth (to nearest tenth of meter)
XX	No. of Animals in Sample (blank if not applicable)
Xxxxx	Average Length of specimens (mm)
Xxxxxx	Average Weight of specimens (g)
XX	Sample State 01 = Fresh frozen 02 = Freeze dried 03 = Oven dried at 105-115° C 04 = Formaldehyde preserved 05 = Oven dried at 60° C 06 = Fresh, preserved at 33-40° F 07 = raw 08 = cooked 09 = canned
Xxxx	Percent Dry (initial determination, to (hundredths of %) (percent that the dry weight is of the wet weight)
Xxxx	Drying Temperature - Initial (°C, to nearest degree)
Xxxx	Percent Dry (at analysis, to hundredths of %) (percent that the dry weight is of the wet weight)
Xxxx	Drying Temperature - At Analysis (°C, to nearest degree)
XX	Navigation 01 = Loran 02 = Radar and/or Fixes 03 = Raydist (w/o complications) 04 = Raydist (with errors, drifting, etc.)

TABLE 2-1. METALS IN ORGANISMS, SEDIMENT AND WATER
(Sheet 3 of 7)

SAMPLE HEADER NO. 1

Characters	Field Description
001	File Type
XXXXXX	Date of file generation (year, month, day)
2	Record Type (code denotes Sample Header)
XXX	Sequence # of Record Type*
AAAAA	Lab sample number (internal laboratory number)
XXXXXXXXXX	Species Code (VIMS Code) or code for sediment (0000000001) or for water including particulate ratter, (0000000002)
A	Sex (M = male, F = female, blank = both sexes used, unknown or not applicable)
XX	Material Analyzed: 01 = muscle 02 = liver 03 = digestive gland 04 = gonad 05 = gills 06 = kidney 07 = spleen 08 = heart. 09 = brain 10 = blood 11 = stomach contents 12 = top 1 1/2" of sediment core 13 = middle 1 1/2" of sediment core 14 = remainder of sediment core 15 = whole organism 16 = water 17 = particulate matter
XXXXXXX	Latitude (degrees, minutes, seconds)
XXXXXXXX	Longitude (degrees, reunites, seconds)
XX/XX/XX	Sample Date (slashes included)
XXX	Sample Time (G.M.T. to nearest tenth of an hour)

---

* The last Sample Header for each sample is followed by a terminator record with characters 1-10 identical to the last Sample Header, followed by 998 as characters 11-13, and with all other characters

TABLE 2-1. METALS IN ORGANISMS, SEDIMENT AND WATER (Sheet 4 of 7)

SAMPLE HEADER No. 2

Characters	Field Description
0 0 1	File Type
XXXXXX	Date of file generation (year, month, day)
2 . '	Record Type (code denotes sample header)
002	Sequence # of Record Type*
AAAAA	Lab sample number
XXX	Barometric pressure (in tens, units and tenths of millibars)
XXXX	Dry-bulb Air Temperature (°C to nearest tenth)
Xxxx	Wet-bulb Air Temperature ("C to nearest tenth)
XX	Wind Direction (code indicating tens of degrees, according to WMO Code 0877)
XX	Wind Speed (to nearest knot)
XX	Sea Direction (code indicating tens of degrees, according to WMO Code 0S85)
X	Sea Height (code indicating height of waves, according to WMO Code 1555)
XX	Swell Direction (code indicating tens of degrees, according to WMO Code 0885)
X	Swell Height (code indicating height of swell, according to WMO Code 1555)
X	Weather (code indicating weather, according to WMO Code 4501)
X	Cloud Type (code indicating cloud type, according to WMO Code 0500)

* The last Sample Header for each sample is followed by a terminator record with characters 1-10 identical to the last Sample Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-1. METALS IN ORGANISMS, SEDIMENT AND WATER
(Sheet 5 of 7)

SAMPLE HEADER NO. 2 (cont.)

Characters	Field Description
X	Cloud Cover (code indicating percent cloud cover, according to WMO Code 2700)
X	Visibility (code indicating visibility, according to WMO Code 4300)
Xxxx	Secchi Disk Depth (to nearest tenth of a meter)
X	Turbidity Measurement Technique 1 = Turbidometer, in JTU 2 = Transmissometer, in % light transmission over 10 cm path

TABLE 2-1. **METALS IN ORGANISMS, SEDIMENT AND WATER**
(Sheet 6 of 7)

DATA RECORD

Characters	Field Description
001	File Type
XXXXXX	Date of file generation (year, month, day)
3	Record Type (code denotes Data Record)
XXX	Sequence # of RecordType
MAAA	Lab sample number
XXXXXXXXXX	Species Code (VIMS Code) or code for sediment (0000000001) or for water (0000000002)
AA	Element Analyzed (standard element abbreviation)
AXX	Method of Analysis: W = data expressed on wet wt. basis D = data expressed on dry wt. basis followed by: 01 = Milford dry ashing method 02 = Repetitive wet ash method using 30 ml HN03 03 = Mercury analysis - flameless AA 04 = Standard sediment method - 50% HNO_3 extraction 05 = Kosiesza - Anal. Services, Inc., arsenic method 06 = Kosiesza - Anal. Services, Inc., Cd, Cr, Pb method 07 = Nondestructive neutron activation 08 = Milford arsenic method 09 = Mercury in sediment, EPA aqua regia method 10 = Wet ash, conc. HNO_3 Method of "Marine Pollution Monitoring: Strategies for a National Policy." Edited by Dr. Edward Goldberg, Scripps Institution of Oceanography

*The last Data Record of each sample is followed by a sample terminator record with characters 1-10 identical to the last Data Record, followed by 998 as characters 11-13, and with all other characters blank. The last sample terminator of the file (at the end of all data) is followed by a file terminator record with 999 in characters 11-13 (characters

TABLE 2-1. METALS IN ORGANISMS, SEDIMENT AND WATER
(Sheet 7 of 7)

DATA RECORD (cont.)

Characters	Field Description
	11 = EPA multielement sediment extraction procedure (11S0_3, HCl, '2°2)"
	(NOTE: Additional code numbers will be assigned as needed)
xx/xx/xx	Date of Analysis (slashes included)
Xxxxxxxx	Concentration - Replicate 1 (there are seven succeeding fields for concentrations of seven additional replicates from the same sample, i.e. , replicates from the same benthic grab, fish, organ, water bottle, etc.) in E format-parts per million of wet weight.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 1 of 9)

MESA Tape Format - Surficial Sediment Characteristics

12/4/74
J. O'Connor
P. Eisen

FILE HEADER

Characters*	Field Description
003	File Type (code denotes this file format)
XXXXXX	Date of file generation (year, month, day)
1	Record Type (code denotes File Header)
(up to 11 A characters)	Vessel (left adjusted]
(up to 6 A characters)	Cruise Number (left adjusted)
xx/xx/xx - xx/xx/xx	Cruise Dates
(up to 19 A characters) ,	Senior Scientist (left adjusted)
(up to end of File-Header A-characters)	Investigator and Institution Responsible for Data (left adjusted)

---

* .x = numeral, A = alphanumeric, specific characters are given

NOTE : The contents of all fields are right adjusted unless otherwise indicated.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 2 of Y)

STATION HEADER NO. 1

characters	Field Description
003	File Type
Xxxxxx	Date of file generation (year, month, day)
2	Record Type
001	Sequence # of Record Type*
AAAAA	Station Number
XXXXXXX	Latitude (degrees, minutes, seconds) .
Xxxxxxxx	Longitude (degrees, minutes, seconds)
xxx	Station Time (GMT to nearest tenth of a hour)
xx/xx/xx	Sample Date
XXXXX	Water Depth (to nearest tenth of a meter)
x	Gear: 1 = Smith-McIntyre 2 = Shipek 3 = gravity core 4 = Box core 5 = Vibra core 6 = Ewing core
xx	Aliquot Method 01 = top 2-3 cm of a 35 mm diam. core from ben'thic grab 02 = top cm scraped from surface of benthic grab 03 = top 8-10 cm scraped from Shipek grab
x	# 'Replicates (taken at this station)
xx	Navigation: 01 = Loran 02 = Radar and/or Fixes 03 = Raydist (w/o complications) 04 = Raydist (with errors, drifting, etc.)

* The last Station Header for each station is followed by a terminator record with characters 1-10 identical to the last Station Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 301 9)

STATION HEADER NO. 1 (cont.)

Characters	Field Description
x	"Grain Size Analysis Method: 1 = sieves 2 = sieves and settling tubes 3 = sieves and automated rapid sediment analyzer 4 = sieves, automated rapid sediment analyzer and coulter counter
x	% Carbonate Method 1 = ,
x	% Carbon Method: 1 = Dry Combustion; Conrad, Chesters, and Keeney (1970) 2 = Hydrogen peroxide oxidation
x	% Carbohydrate Method: 1 = Gerchikov and Hatcher (1972)
x	No. of bottom photographs taken
x	Data Record Type 3 = 9 ϕ gradations 4 = 42 ϕ gradations

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 4 of 9)

STATION HEADER NO. 2

Characters	Field Description
003	File Type
XXXXXX	Date of file generation (year, month, day)
2	Record Type (code denotes station header)
002	Sequence # of Record Type*
AAAAA	Station Number
xxx	Barometric pressure (in tens, units and tenths of millibars)
XXXX	Dry-bulb Air Temperature (°C to nearest tenth)
Xxxx	Wet-bulb Air Temperature (°C to nearest tenth)
xx	Wind Direction (code indicating tens of degrees, according to WMO Code 0877)
xx	Wine? Speed (to nearest knot)
xx	Sea Direction (code indicating tens of degrees, according to WMO Code 0885)
x	Sea Height (code indicating height of waves, according to WMO Code 1555)
XX	Swell Direction (code indicating tees of degrees, according to WMO Code 0885)
x	Swell Height (code indicating height of swell, according to WMO Code 1555)
x	Weather (code indicating weather, according to WMO Code 4501)
x	Cloud Type (code indicating cloud type, according to WMO Code 0500)

* The last Station Header for each station is followed by a terminator record with characters 1-10 identical to the last Station Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 5 of 9)

STATION HEADER NO. 2 (cont.)

Characters	Field Description
X	Cloud Cover (code indicating percent cloud cover, according to WMO Code 2700)
X	Visibility (code indicating visibility, according to WMO Code 4300)
Xxxx	Secchi Disk Depth (to nearest tenth of a meter)
X	Turbidity Measurement Technique 1 = Turbidometer, in JTU 2 = Transmissometer, in % light transmission over 10 cm path

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 6 of 9)

DATA RECORD - Type 3 (9 ϕ gradation)

Characters	Field Description
003	File Type
Xxxxxx	Date of file generation (year, month, day)
3	Record Type
xxx	Sequence # of Recrod Type*
AAAAA	Station Number
xx	Replicate Number
Xxxx	Mean Grain Size (ϕ units, 2 decimal places, i.e., XX.XX)
Xxxx	Median Grain Size (ϕ units, 2 decimal places)
Xxxx	Modal Grain Size (ϕ units, 2 decimal places)
Xxxx	Standard Deviation (ϕ units, 2 decimal places)
Xxxx	Skewness (ϕ units, 2. decimal places)
Xxxx	Kurtosis (ϕ units, 2 decimal places)
Xxxx	% > -2ϕ (2 decimal places)
Xxxx	% -2 to -1ϕ (2 decimal places)
Xxxx	% -1 to 0ϕ (2 decimal places)
Xxxx	% 0 to 1ϕ (2 decimal places)
Xxxx	% 1 to 2ϕ (2 decimal places)
Xxxx	% 2 to 3ϕ (2 decimal places)
Xxxx	% 3 to 4ϕ (2 decimal places)
Xxxx	% 4 to 641 (2 decimal places)
Xxxx	% 6 to 8ϕ (2 decimal places)

* The last data record of each station is followed by a terminator record with characters 1-10 identical to the last Data Record, followed by 998 as characters 11-13, and with all other characters blank. The last Data Record of the entire file is followed by a terminator record (last record of the file) with characters 1-10 identical to the last Data Record, followed by 999 as characters 11-13, and with all other characters blank.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 7 of 9)

DATA RECORD - *Type* 3 (9 gradations) (cont.)

Characters	Field Description
Xxxx	% < 8ϕ (2 decimal places)
Xxxx	% Carbonate (2 decimal places)
Xxxx	% Carbon (2 decimal places)
Xxxx	% Carbohydrate (2 decimal places)

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 8 of 9)

DATA RECORD - Type 4(42ϕ gradations)

Characters	Field Description
003	File Type
XXXXXX	Date of file generation (year, month, day)
4	Record Type
xxx	Sequence # of Record Type*
AAAAA	Station Number
xx	Replicate Number
Xxxx	Mean Grain Size (ϕ units, 2 decimal places, i.e., XX.XX)
Xxxx	Median Grain Size (ϕ units, 2 decimal places)
Xxxx	Modal Grain Size (ϕ units, 2 decimal places
Xxxx	Standard Deviation (ϕ units, 2 decimal places)
Xxxx	,Skewness (ϕ units, 2 decimal places)
Xxxx	Kurtosis (ϕ units, 2 decimal places)
Xxxx	%> -2ϕ (2 decimal places)
Xxxx	% -2 to -1ϕ (2 decimal places)
Xxxx	% -1 to -.75ϕ (2 decimal places)
Xxxx	% -*75 to -.5ϕ (2 decimal places)
"	" " " " " " "
"	" n " " " " "
"	" " " " " " "

(0.25ϕ categories from -.5$ to 9ϕ, each in % of total sediment weight to 2 decimal places)

"	" " " " " " "
"	" " " " " " "
"	" " " " " " "

---

* The last data record of each station is followed by a terminator record with characters 1-10 identical to the last Data Record, followed by 998 as characters 11-13, and with all other characters blank. The last Data Record of the entire file is followed by a terminator record (last record of the file) with characters 1-10 identical to the last Data Record, followed by 999 as characters 11-13, and with all other characters blank.

TABLE 2-2. SURFICIAL SEDIMENT CHARACTERISTICS
(Sheet 9 of 9)

DATA RECORD - Type 4 (42 gradations)(cont.)

Characters	Field Description
Xxxx	% <9ϕ (2 decimal places)
Xxxx	% Carbonate (2 decimal places)
Xxxx	% Carbon (2 decimal places)
Xxxx	% Carbohydrate "(2 decimal places]

TABLE 2-3. WATER PHYSICS AND CHEMISTRY (Sheet 1 of 5)

MESA Tape Format - Water Physics and Chemistry

12/5/74
J. O'Connor
P. Eisen

FILE HEADER

Characters*	Field Description
004	File Type (code denotes this file format)
XXXXXX	Date of file generation (year, month, day)
1	Record Type (code denotes File Header)
(up to 11 A characters)	Vessel (left adjusted)
(up to 6 A characters)	Cruise Number (left adjusted)
xx/xx/xx - xx/xx/xx	Cruise Dates
(up to 19 A characters]	Senior Scientist (left adjusted)
(up to end of Header) (A characters)	Investigator and Institution Responsible for Data (left adjusted)

* x = numeral, A = alphanumeric, specific characters are given.

NOTE : The contents of all fields are right adjusted unless otherwise indicated.

TABLE 2-3. WATER PHYSICS AND CHEMISTRY (Sheet 2 of 5)

STATION HEADER NO. 1

Characters	Field Description
004	File Type
Xxxxxx	Date of file generation (year, month, day)
2	Record Type (code denotes sample header)
001	Sequence # of Record Type*
AAAAA	Station Number
XXXXXXX	Latitude (degrees, minutes, seconds)
XXXXXXXX	Longitude (degrees, minutes, seconds)
xxx	Station Time (GMT to nearest tenth of of a hour)
xx/xx/xx	Sampling Date (year/ month/ day)
Xxxxx	Water Depth (to nearest tenth of "a meter)
xx	Navigation: 01 = Loran 02 = Radar and/or Fixes 03 = Raydist (w/o complications) 04 = Raydist (with errors, drifting, etc.!
	End-of-Field Filler

---

* The last Station Header for each station is followed by a terminator record with characters 1-10 identical to the last Station Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-3, WATER PHYSICS AND CHEMISTRY (Sheet 3 of 5)

STATION HEADER NO. 2

Characters	Field Description
004	File Type
XXXXXX	Date of file generation (year, month, day)
2	Record Type {code denotes sample header)
0 0 2	"Sequence # of Record Type*
AAAAA	Station Number
xxx	Barometric pressure (in tens, units and tenths of millibars)
xxxx	Dry-bulb Air Temperature (°C to nearest tenth)
Xxxx	Wet-bulb Air Temperature (°C to nearest tenth)
xx	Wind Direction (code indicating tens of degrees, according to WMO Code 0877)
xx	Wind Speed (to nearest knot)
xx	Sea Direction (code indicating tens of degrees, according to WMO Code 0885)
x	Sea Height (code indicating height of waves, according to WMO Code 1555)
xx	Swell Direction (code indicating tens of degrees, according to WMO Code 0885)
x	Swell Height (code indicating height of swell, according to WMO Code 1555)
x	Weather (code indicating weather, according to WMO Code 4501)

---

* The last Station Header for each station is followed by a terminator record with characters 1-10 identical to the last Station Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-3. WATER PHYSICS AND CHEMISTRY (Sheet 4 of 5)

STATION HEADER NO. 2 (cont.)

Characters	Field Description
X	Cloud Type (code indicating cloud type, according to WMO Code 0500)
x	Cloud Cover, (code indicating percent cloud cover, according to WMO Code 2700)
x	Visibility (code indicating visibility, according to WMO Code 4300)
Xxxx	Secchi Disk Depth (to nearest tenth of a meter)
x	Turbidity Measurement Technique 1 = Turbidometer, in JTU 2 = Transmissometer, in % light transmission over 10 cm path

TABLE 2-3. WATER PHYSICS AND CHEMISTRY (Sheet 5 of 5)

DATA RECORD

characters	Field Description
004	File Type
Xxxxxx	Date of file generation (year, month, day)
3	Record Type
xxx	Sequence # of Record Type*
AAAAA	Station Number
Xxxx	Sample Depth (to nearest tenth of a meter)
Xxxxx	Temperature (°C to nearest thousanth)
Xxxxx	Salinity (in parts per thousand to nearest thousanth)
xx XX	Sigma-t (to nearest hundredth)
Xxxx	Turbidity (units variable, but all entered to nearest tenth - Turbidity Measurement Technique ant? units given in Sample Header #1)
xxx	pH (to nearest hundredth)
Xxxx	Dissolved Oxygen (in ml/l to nearest hundredth)
xxx	Ammonia (in microgram-atoms/l to nearest tenth)
xxx	Nitrite (in microgram-atoms/l to "nearest hundredth)
xxx	Nitrate (in microgram-atoms/l to nearest hundredth)
xxxx	Silicate (in microgram-atoms/l to nearest hundredth),
xxx	Phosphate-Inorganic (in microgram-atoms/l to nearest hundredth)

* The last Data Record of each station is followed by a terminator record with characters 1-10 identical to the last Data Record, followed by 998 as characters 11-13, and with all other characters blank. The last Data Record of the entire file is followed by a terminator record (last record of the file) with characters 1-10 identical to the last Data Record, followed by 999 as characters 11-13, and with all other characters blank.

TABLE 2-4. BENTHIC MACROFAUNA (Sheet 1 of 5)

MESA Tape Format - Benthic Macrofauna

12/5/74
J. O'Connor
P. Eisen

FILE HEADER

Characters*	Field Description
002	File Type (code denotes this file "format)
XXXXXX	Date of file generation (year, month, day)
1	Record Type (code denotes File Header)
(up to 11 A characters)	Vessel (left adjusted)
(up to 6 A characters)	Cruise Number (left adjusted)
xx/xx/xx - xx/xx/xx	Cruise Dates
(up to 19 A characters)	Senior Scientist (left, adjusted)
(up to 22 A characters)	-Investigator and Institution Responsible for Data (left adjusted)

* x = numeral, A = alphanumeric, specific characters are given.

NOTE: The contents of all fields are right adjusted unless otherwise indicated.

TABLE 2-4. BENTHIC MACROFAUNA (Sheet 2 of 5)

SAMPLE HEADER NO. 1

characters	Field Description
002	File Type
Xxxxxx	Date of file generation (year, month, day)
2	Record Type (code denotes Sample Header)
xxx	Sequence # of Record Type*
AAAAA	Sample No. (either sequential or other numbers assigned by investigators)
Xxxxxxx	Latitude (degrees, minutes, seconds)
Xxxxxxxx	Longitude (degrees, minutes, seconds)
xxx	Sample Time (G.M.T. to nearest tenth of a hour)
xx/xx/xx	Sample Date (slashes included)
Xxxxx	Water Depth (to nearest meter)
x	Gear: 1 = Smith-McIntyre Grab 2 = Peterson Grab
xx	# Replicates (taken at this station)
Xxxx	Screen Size (mm, F5.3)
xx	Navigation: 01 = Loran 02 = Radar and/or Fixes 03 = Raydist (w/o complications) 04 = Raydist (with errors, drifting, etc.)
27 blanks	End-of-Field Filler

* The last Sample Header for each sample is followed by a terminator record with characters 1-10 identical to the last Sample Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-4. BENTHIC MACROFAUNA (Sheet 3 of 5)

SAMPLE HEADER NO. 2

Characters	Field Description
002	File Type
XXXXXX	Date of file generation (year, month, clay)
2	Record Type (code denotes sample header)
002	Sequence # of Record Type*
AAAAA	Lab sample number
XXX	Barometric pressure (in tens, units and tenths of millibars)
XXXX	Dry-bulb Air Temperature ("C to nearest tenth)
XXXX	Wet-bulb Air Temperature ("C to nearest tenth)
XX	Wind Direction (code indicating tens of degrees, according to WMO Code 0877)
xx	Wind Speed (to nearest knot)
xx	Sea Direction (code indicating tens of degrees, according to WMO Code 0885)
x	Sea Height (code indicating height of waves, according to WMO Code 1555)
xx	Swell Direction (code indicating tens of degrees, according to WMO Code 0885)
x	Swell Height (code indicating height of swell, according to WMO Code 1555)
x	Weather (code indicating weather, according to WMO Code 4501)
x	Cloud Type (code indicating cloud type, according to WMO Code 0500)

* The last Sample Header for each sample is followed by a terminator record with characters 1-10 identical to the last Sample Header, followed by 998 as characters 11-13, and with all other characters blank.

TABLE 2-4. BENTHIC MACROFAUNA (Sheet 4 of 5)

SAMPLE HEADER NO. 2 (cont.)

Characters	Field Description
x	Cloud Cover (code indicating percent cloud cover, according to WMO Code 2700)
x	Visibility (code indicating visibility, according to WMO Code 4300)
Xxxx	Secchi Disk Depth (to nearest tenth of a meter)
x	Turbidity Measurement Technique 1 = Turbidometer, in JTU 2 = Transmissometer, in % light transmission over 10 cm path

TABLE 2-4. BENTHIC MACROFAUNA (Sheet 5 of 5)

DATA RECORD

Characters	Field Description
002	File Type
XXXXXX	Date of file generation (year, month, day)
3	Record Type
xxx	Sequence # of Record Type*
AAAAA	Sample Number
xx	Replicate # (replicates without specimens not entered on tape)
Xxxxxxxxxx	Species Code (VIMS Code)
Xxxxx	Count (# of individuals)
Xxxxxxx	Ash-Free Wt. (g, F8.4)
Xxxxxxx	Wet Wt. (g, F8.3)
XXXXXXX	Corrected Wet Wt. (g, F8.3)
xx/xx/xx	Date of Wet Wt. Measurement
21 blanks	End-of-Field Filler

* The last Data Record of each sample is followed by a sample terminator *record* with characters 1-10 identical to the last Data Record, followed by 998 as characters 11-13, and with all other characters blank. The last sample terminator of the file (at the end of all data) is followed by a file terminator record with 999 in characters 11-13 (characters 1-10 identical to the last Data Record) and with all other characters blank.

3.0 STORET (ENVIRONMENTAL PROTECTION AGENCY)

STORET (Storage and Retrieval) is EPA's information system which is used to maintain a centralized water quality and water pollution-cause data base for use by federal and state agencies through remote access terminals.

The STORET System, diagrammatically shown in Figure 3-1, currently operates on a GSA IBM 370/ 155 computer at Suitland, Maryland which is directly accessible through a network of telecommunication terminals, including low-speed terminals (IBM 2741, DATEL 30, TTY, NOVAR 5-41, etc.) and medium-speed terminals (IBM 2780, Data 100, COPE 30, IBM 1130, etc.). User agencies supply their own terminals to interface the system in either interactive or remote batch modes.

3.1 Data Storage and Retrieval

The STORET data base consists of two files: the water quality file (WQF) and the general point source file (GPSF). The WQF contains three types of data which define water pollution: water use categories, criteria or standards for water quality, and actual sampled water quality parameters (over 1600 parameters divided into 17 major groups -- summarized in Table 3-1). The GPSF contains an inventory of pollution point sources from which discharges affecting water quality can be determined and an action file of implementation plans which describes when and how the discharges will be reduced or eliminated. The GPSF was created to establish a common national data base, and to associate data with discharge and action. No data is admitted to the GPSF without a formal input edit and a verification of data quality and relevance.

Under STORET, the user may select any element or any combination of elements in the GPSF file and address only that portion of the file he wishes to use for data retrieval. GPSF handling routines permit the user to design his own output format and make use of resident summary capabilities.

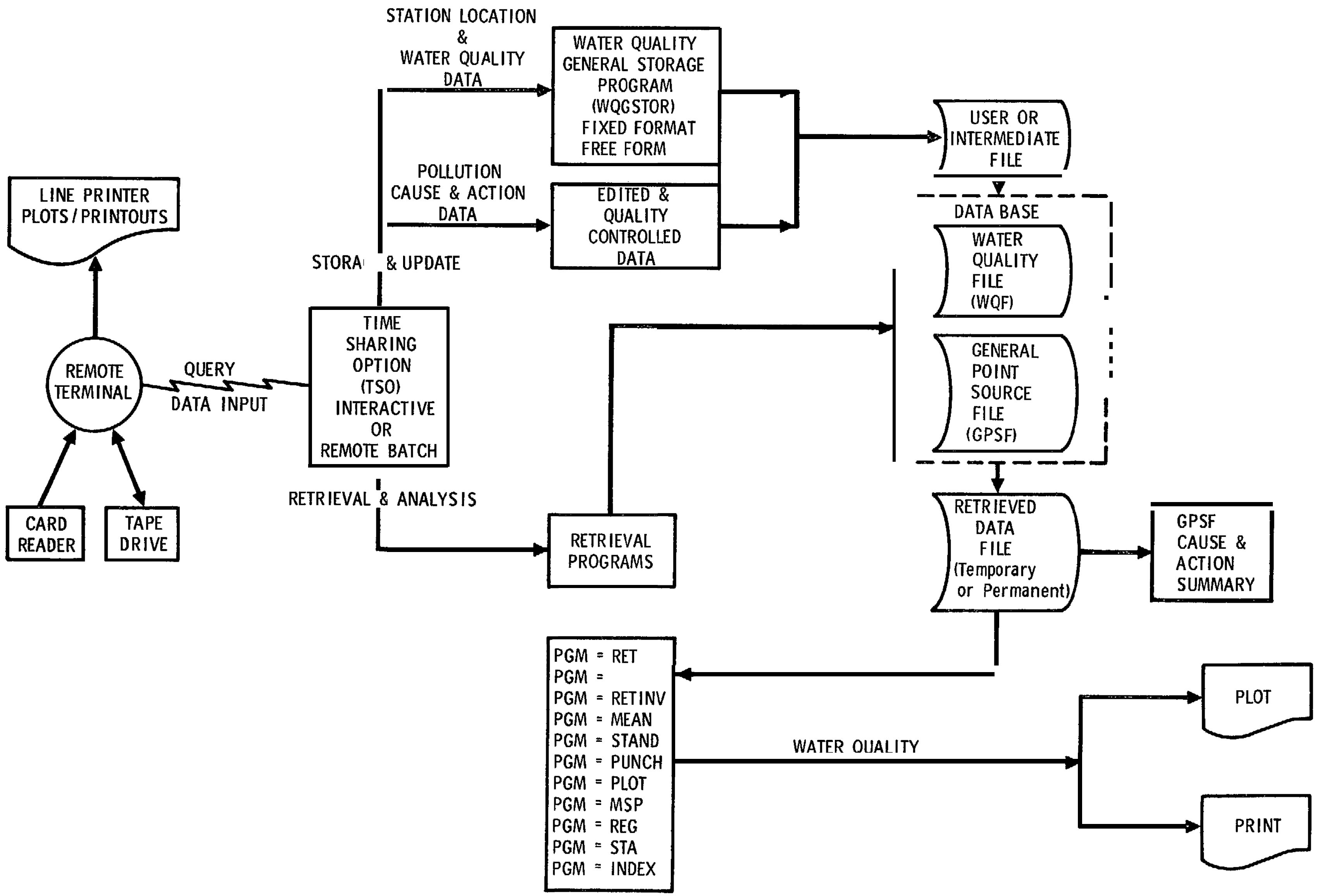


FIGURE 3-1. STORET - EPA COMPUTERIZED INFORMATION SYSTEM

TABLE 3-1. SUMMARY OF STORET PARAMETER GROUPS

Parameter Groups	Total No. of Parameters
ADMINISTRATIVE	33
BACTERIOLOGICAL	44
BIOLOGICAL	333
DISSOLVED OXYGEN	6
FLOW	10
GENERAL INORGANIC	64
GENERAL ORGANIC	67
METALS	186
NITROGEN	39
OXYGEN DEMAND	96
PESTICIDES	169
PHOSPHOR US	32
PHYSICAL	160
RADIOLOGICAL	229
SOLIDS	132
TEMPERATURE	2
MISCELLANEOUS	92
TOTAL	**1694**

STORET water quality data is grouped by agencies and stations. Stations (representing particular locations along some waterway) may be sampled by State agencies, interstate commissions, USGS, EPA, other federal agencies, or in some cases, local environmental groups. Data entered into STORET are labeled with a station number and a sampling agency code. An additional State code and station location is also supplied for identification, the latter being either a latitude-longitude or a river mile index (RMI) defining the river mileage from the mouth of the stream to the station.

STORET provides numerous options for storage of station location information. Stations may be identified by station number, located by geographical coordinates and hydrolic index (RMI). Geographical location may be used to reduce time and effort for data handling to define locations and retrieval areas not associated with river systems. Whenever possible, both geographical and hydrolic methods are used. (Examples of station location input forms are provided in Figures 3-2 and 3-3 and 3-4).

Water quality parameters may be stored using Standard (fixed-field data card) or Decimal (free -form data card) input procedures. (Examples of Digital input forms are provided in Figure 3- 5). All parameter data are associated with prime and/or secondary station numbers and only one set of observations may be stored under a single data -time -location -depth combination.

To access WQ data, the user or analyst must know either the station numbers, the reach of river, or geographical area for which data is desired. If the station numbers are known, a data retrieval for those stations can be made immediately, but if not known, STORET has two programs which will search the selected geographical area for the desired station numbers. Although user data is expected to be stored in the STORET data base for general use, all data in STORET files cannot be accessed by

FWPCA STORET SYSTEM
DIVISION OF POLLUTION SURVEILLANCE
USER INFORMATION & STATION DATA
REQUIRED FOR STORAGE AND CHANGES

AGENCY CARD

AGENCY (USER) CODE [| | | | | | |] 1 – 8 BLANK 9-16

UNLOCKING KEY [| | | | | | |] 17 – 24

USER NAME, LOCATION, PROJECT, ETC. [ ] 25 – 42
[ ] 43 – 61

DEPTH-FEET (F) OR METERS (M) [ ] 62

STORE CODE [| |] 63 – 65

UNLOCKING DATE
YEAR [|] 74 75 MO. [|] 76 77

STATION TYPE [| | | | | H] 66 – 73

CONTROL CODE [|] 78 79 • A1 80

STATION CARD

SEQUENCE NUMBER [| |] 1 – 3

PRIME STATION CODE [ ] 4 – 18 * BLANK 19 – 33

1) SECONDARY STATION CODE [ ] 34 – 45 *

2) SECONDARY STATION CODE [ ] 46 – 57 *

3) SECONDARY STATION CODE [ ] 58 – 67 *

* LEFT JUSTIFY

STATE CODE [|] 68 69 COUNTY [| |] 70 – 72 CITY [| | | |] 73 – 77

CONTROL CODE m 78 79 • S1 80

FIGURE 3-20 AGENCY AND STATION INPUT FORMS

DEPARTMENT 0? HEALTH. EDUCATION, ANO WELFARE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

STORET II - LOCATION DATA

HEADER CARD I (Required)

CARD SORTING NUMBER — 1-3
4-6 BLANK

LATITUDE (Degrees, Minutes, 0.1 Seconds) — 7.13

LONGITUDE (Degrees, Minutes, 0.1 Seconds) — 14.21

AGENCY CODE — 22-27

PRECISION CODE (Use for original storage only) — 20

UNITS CODE FOR DEPTH (F for Feet and M for Meters) — 29

TOTAL DEPTH OF WATER OR WELL (Use for original storage only) — 30-32

STATE CODE (Use for original storage only) — 33-34

TYPE OF STATION CODE (Use for original storage only) — 35-42
43-67 BLANK

STATION CODE (Optional, Left Justify) — 68-79 — 1 — 80

HEADER CARD III (Optional and Used for Original Storage Only)

CARD SORTING NUMBER (Same as Col. 1-3 on Card I) — 1-3
4-12 BLANK

STATE NAME (13-28):

MAJOR BASIN NAME (29-52):

MINOR BASIN NAME (S3-791: — 3 — 80

HEADER CARD IV (Optional and Used for Original Storage Only)

CARO SORTING NUMBER (Same as Col. 1-3 On Cards I and III) — 1-3
4-6 BLANK

MINOR BASIN NAME - CONT. FROM CARD III [7.191:

LOCATION NAME (20-51 1:

LOCATION NAME - CON T.?

S2-79 BLANK — 4 — 80

FWPCA - 2e
7-66

FIGURE 3-3. LOCATION INPUT FORM

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

STORET SYSTEM - STATION LOCATION DATA

STATION DESIGNATION: CARD I STATION CODE SERIAL 1-6

TERMINAL MAJOR BASIN: 7-8

TERMINAL MINOR BASIN: 9-10

TERMINAL STREAM NUMBER 11-13

LEVEL	INDEX	MILES
1		14-19
2	20-25	26-31
3	32-36	37-41
4	42-45	46-50
5	51-54	55-59
6	60-63	64-68
7	69-72	73-76

LAST LEVEL USED 77-78 LOCATION IN CROSS SECTION 79 [1] 80

CARD II REPEAT COLUMNS 1-13 ABOVE

LEVEL	INDEX	MILES
8	14-17	18-21
9	22-25	26-29
10	30-33	34-37
11	38-41	42-45
12	46-49	50-53

54-79 BLANK [2] 80

CARD III CARD SORTING NUMBER 1-6

STATE NAME (13-28):

MAJOR BASIN IN WHICH STATION IS LOCATED (29-52):

MINOR BASIN IN WHICH STATION IS LOCATED (53-79): [3] 80

CARD IV CARD SORTING NUMBER 1-6

MINOR BASIN NAME- CONT. FROM CARD III (7-19):

LOCATION NAME (20-51):

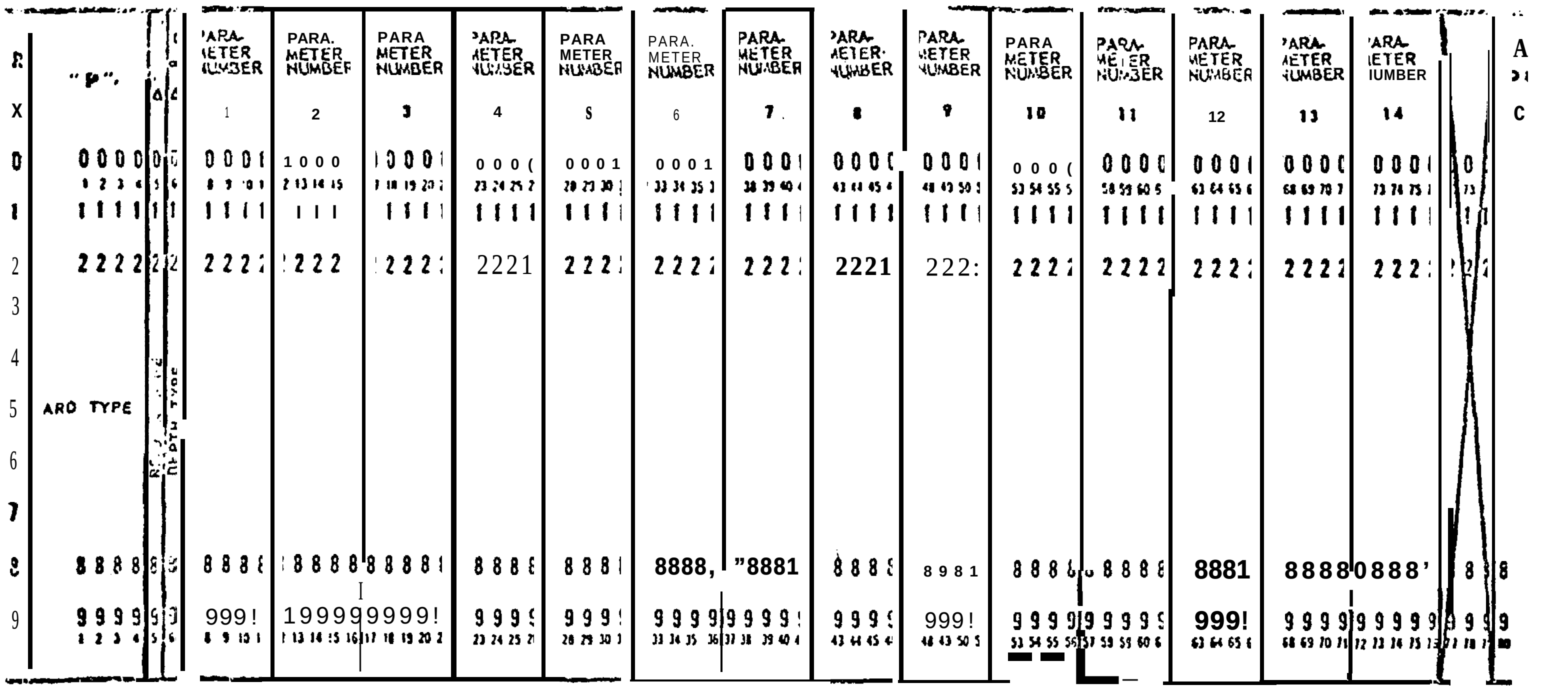
LOCATION NAME (CONT.):

REMARKS [4] 80

FIGURE 3-4. STATION LOCATION INPUT FORM

Layout Form -" 80 Column Card

DECIMAL INPUT PROGRAM



Title ....

Prepared By .... For Program ....

By Programmer .... Checked By ....

Date .... Remarks ....

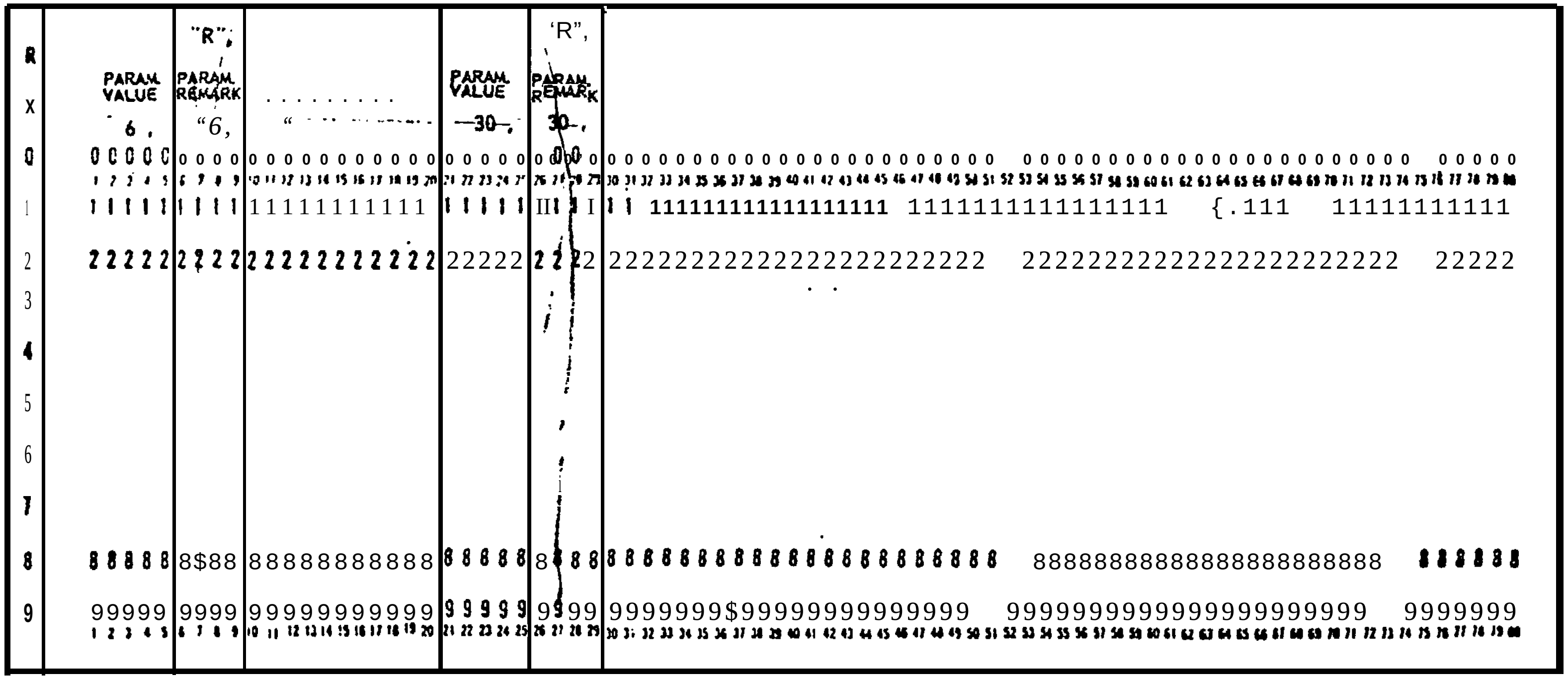
....

Modifica .... Page 1 of 4

FIGURE 3-5. DIGITAL INPUT FORM (1 of 2)

layout Form - 80 Column Card

DECIMAL INPUT PROGRAM



Title ....

Prepared By...... .... **For Program** ....

By Programmer . . . . Checked By ....

Date . . . . **Remarks** ....

.. ..

Modification .... Page . . . . . . .4! . . . . . . .of 4 ....

FIGURE 3-5. DIGITAL INPUT FORM (2 of 2)

all interested parties, since some of it is considered "sensitive". This data is protected by password key.

3.2 Manipulate on Capability es

Once the station data are retrieved, they can be processed in a variety of ways. Table 3-2 describes the major programs for retrieval and analysis of water quality data and any of these programs can be called by the user to perform his analysis.

STORET is essentially a complex of PL/ 1 language computer programs and program elements which are activated by queries entered at remote terminal locations. Special training is required to use the system. There are two types of programs that provide the data processing capabilities: Water Quality Programs and Waste Facility Inventory Programs. The former type stores, retrieves, and analyzes water quality data and can compare this information with acceptable standards. The latter type of programs store and retrieve data related to the location, treatment practices, and pollution abatement status of municipal and industrial waste facilities.

The system includes specific options to change or delete station type, secondary station number, station location, descriptive textual information, and the values of one or more parameters on specific date(s). Key data, such as agency code and prime station number, can be altered by deleting and restoring the entire associated record.

TABLE 3-2. STORET WATER QUALITY RETRIEVAL AND ANALYSIS PROGRAMS

NAME	FUNCTION
RET	For selected stations, retrieves (by any option) raw data and provides a summary paragraph of water measurements.
LOC	Retrieves stations in a specified area outlined by a polygon defined by latitude/longitude and plots the geographic area with CA LCOMP routines.
INDEX	Provides location data found in station headings for all stations designated with any retrieval option.
INVENT	Retrieval (by station number only) of water quality inventory including all parameters monitored, number of observations, mean, variance, standard, deviation, coefficient of variance, standard error, maximum, minimum, and beginning and ending sampling dates.
RETINV	Same as INVENT, except it allows the additional capabilitiess of retrieval by RMI and/ or latitude/ longitude specifications as well as by code/station number,
STAND	Compares water quality data with a set or sets of criteria entered at retrieval which could be the water quality standards.
MEAN	Retrieves raw rater quality data and performs basic statistical operations such as number of observations, maximum obser - vation, minimum observation and mean. (Retrieval by selected parameters).
MSP	The Multiple Station Plot program allows the display of certain parameter statistics as functions of stations.
PLOT	Retrieves raw water quality data and produces a cartesian plot of the specified data.

TABLE 3-2. (Continued)

NAME	FUNCTION
REG	Compares one parameter with another (regression analysis), either at the same or different sites.
STA	**Provides a listing of all stations for designated agency code(s), flagging the primary station numbers.**
PUNCH	Retrieves and prints the raw water quality data and prints punched cards containing the station numbers, sampling date, and the raw data,

4.0 UBSDB (WESTINGHOUSE OCEANIC RESEARCH LABORATORY)

Westinghouse's Upper Bay Survey data base management system (UBSDB) has been used in a scientific interdisciplinary survey to determine the levels, pathways and effects of contaminants in the Chesapeake Bay. This survey was conducted jointly by Westinghouse Oceanic Research Laboratory, University of Maryland, and Johns Hopkins University. The areas of investigation encompassed hydrography, meteorology, marine geology, biochemistry, microbiology, and marine biology disciplines.

4.1 The UBSDB System

UBSDB, diagrammatically shown in Figure 4-1, provides a storage, retrieval and analysis capability for the environmental data collected by investigators of different disciplines in the Chesapeake Bay Survey. UBSDB is an extension of SYSTEM 2000, a data base management system described in Appendix E. The Upper Bay Survey Data Base utilizes the Control Data CYBERNET, a commercial time-sharing service accessed in Rockville, Maryland. The CYBERNET service provides an extensive library of programs for users' selection. The users can unload their data or system onto magnetic tapes, store those tapes in the center at a minimal cost, and reload their entire system in minutes when needed.

One of the basic considerations of Westinghouse in selecting SYSTEM 2000 was to facilitate retrieval and analysis of diversified data by principal investigators and scientists with little or no previous computer experience. Other considerations included the following: the data base had to have a flexible Updating and expansion capability; the system had to facilitate prompt retrieval of any specific information item; the system had to provide the scientist with direct data manipulation, comparisons and statistical analysis capability; the system had to satisfy both the standard, predicted information needs and unpredictable information requests from multiple users; and the system should not become obsolete or require major revisions with changes in computer technology.

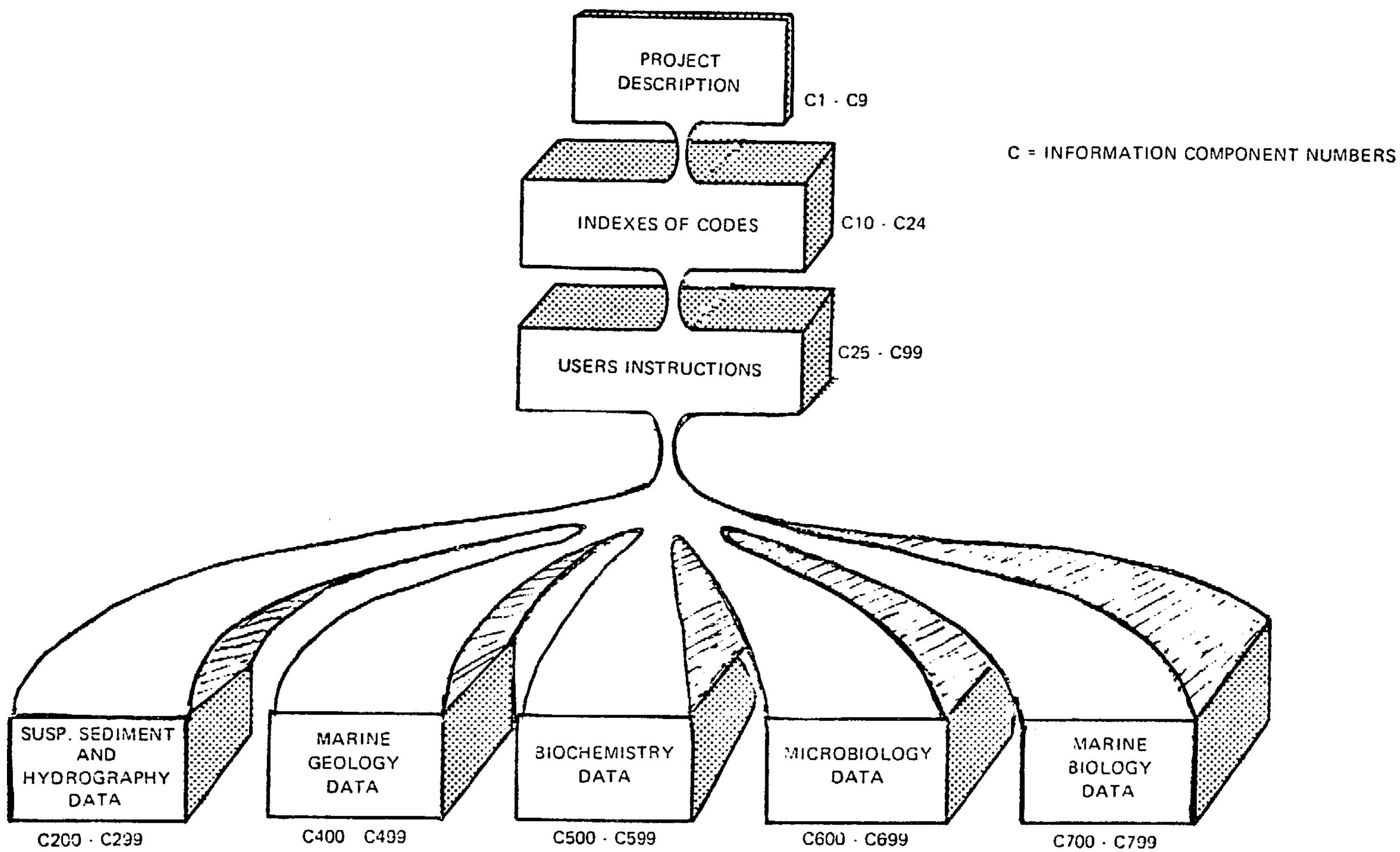


FIGURE 4-1. UPPER BAY SURVEY DATA BASE

4.2 Data Collection

UBSDB data collection forms were developed and used by each individual discipline during the initial recording of samples. Once the samples were analyzed and the data parameters investigated and quantified, data was transcribed onto special forms for keypunch and subsequent entry into the data base. An example of these forms used by the suspended Sediment/Hydrography discipline is shown in Figure 4-2.

Currently, the UBSDB data base contains about 35,000 entries derived from 1500 samples of data. Each sample taken at a major sampling station was identified with the following information:

- Type of Sample
- Station Code
- Date
- Time of Day
- Depth (meters)

4.3 Hardware Considerations

Access to the UBSDB data base under CYBERNET can be made from any geographic location using telephone lines and appropriate data terminals. The data base can be used in remote batch or interactive modes of operation. Each mode of operation requires different types of terminals.

Batch mode terminals:

- Control Data - CDC 200 UT, CDC 730, CDC 8231
- IBM 1130 Computer Systems
- Honeywell 200 Series Computer Systems
- UNIVAC 9200 Computer Systems
- COPE Series Terminals
- Data 100 Terminals
- Mohawk Terminals
- Tektronix 4010, 4012, 4013

	201	202	203	204	205	206		208	209	210		211		212	213	214	215
SPECIAL SAMPLE CODE (1-4)	SPECIAL KEY SAMPLE CODE (5-9)	STATION CODE (10-12)	DATE OF SAMPLE M M / D D / Y Y (13-20)	TIME OF SAMPLE (22-24)	WIND DIRECTION 360° (25-27)	WIND SPEED KTS. (28-30)	WEATHER CODE (31)	AIR TEMP. DRY BULB (CENTGR.) (32-35)	AIR TEMP. WET BULB (CENTGR.) (36-39)	DEPTH OF SAMPLE (METERS) (40-43)	UNADJUSTED WATER TEMP. (CENTGR.) (44-48)	ADJUSTED WATER TEMP (CENTGR.) (49-53)	UNADJUSTED WATER CONDUCTIVITY (54-59)	ADJUSTED WATER CONDUCTIVITY (60-65)	WATER PH (66-71)	WATER OXYGEN (ML/L) (72-77)	WATER TURBIDITY (78-80)
A 1		01A	12/13/74	427	140	145				0.0		5.09					
A 2		01A	12/13/74	430	140	145				21.0		5.06					
A 3		01A	12/13/74	433	140	145				4.0		5.06					

SUSPENDED SEDIMENT & HYDROGRAPHY DATA

PAGE 2 of 2

	216	217	218	219	220	221	222	223	224	225	226	227	228
SPECIAL SAMPLE CODE (1-4)	WATER CHLORINITY (°/oo) (5-9)	WATER SALINITY (°/oo) (10-14)	WATER SIGMA T (15-19)	CONCEN. TOTAL SUS. SEDIMENTS MG/L (20-25)	SUSPENDED SEDIMENTS % ORGANIC (26-29)	VESSEL CODE (30-31)	STATION LATITUDE ° ' " (32-38)	STATION LONGITUDE ° ' " (39-45)	DNR STATION CODE (46-52)	MD. GRID COORDINATE EAST (53-57)	MD. GRID COORDINATE NORTH (58-61)	STATION DEPTH (METERS) (62-66)	SAMPLE COMMENT (67-80)
B 1	0.01	0.05	0.06	41.33	15.2	2	393255	760447	XKH2952	10595	6260	12.0	
B 2	0.01	0.05	0.07	42.57		2	393255	760447	XKH2952	10595	6260	12.0	
B 3	0.01	0.05	0.06	40.55		2	393255	760447	XKH2952	10595	6260	12.0	

FIGURE 4-2. UBSDB DATA RECORDING FORMS

Interactive mode terminals:

- Any terminal which has 10 or 30 characters per second transmission capability.
- Texas Instruments, Inc. 700 Series
- ASR Teletypes (most all models)
- Hewlett Packard **9866A.**

APPENDIX E

COMMERCIAL DATA SYSTEMS

GIM -- TRW SYSTEMS

GIPSY -- UNIVERSITY OF OKLAHOMA

IMS -- INTERNATIONAL BUSINESS MACHINES

SYSTEM 2000 -- MRI SYSTEMS

1.0 GIM (TRW SYSTEMS)

Generalized Information Management (GIM) is a data management system developed by TRW Systems Group and adapted for operation on the Computer Science Corporation Teleprocessing System (CSTS) and INFONET -- an on-line time sharing service. Operating under INFONET, GIM (also known as IGIM) supports multiple on-line users through terminals of all speeds including the IBM 2741, UNIVAC DCT 500 and DATA POINT 2200.

GIM runs on INFONET's UNIVAC 1108 computer. However, the system is also used at over twenty other locations, mainly in government areas, on IBM 360/370 series machines under the OS operating system.

1.1 The GIM Sys tern

The GIM system structure, illustrated in Figure 1-1, consists of software, a master data base, under data bases, temporary working files, and several system support files and command macros. The system operates under the supervision of CSTS which controls all user input/output, time slicing, and other basic operating system tasks. Within GIM, all resource management functions such as buffer management, program module switching, and contingency processing are under control of the GIM EXEC subsystem.

For interfacing with terminal users, GIM uses a communications module (GIMCOM) providing special editing and printing control not available for batch GIM activity. Running GIM in batch is like running on-line. That is, all the user does is make a CSTS file with all of the user's GIM statements typed line by line. This file is then submitted for batch processing by using the "JOB" command. Queued input and output images are stored on buffe red communications files established during program execution. These files allow reprocess ing of a previous statement with modifications and the reprinting of output from any previous statement processed during the GIM session.

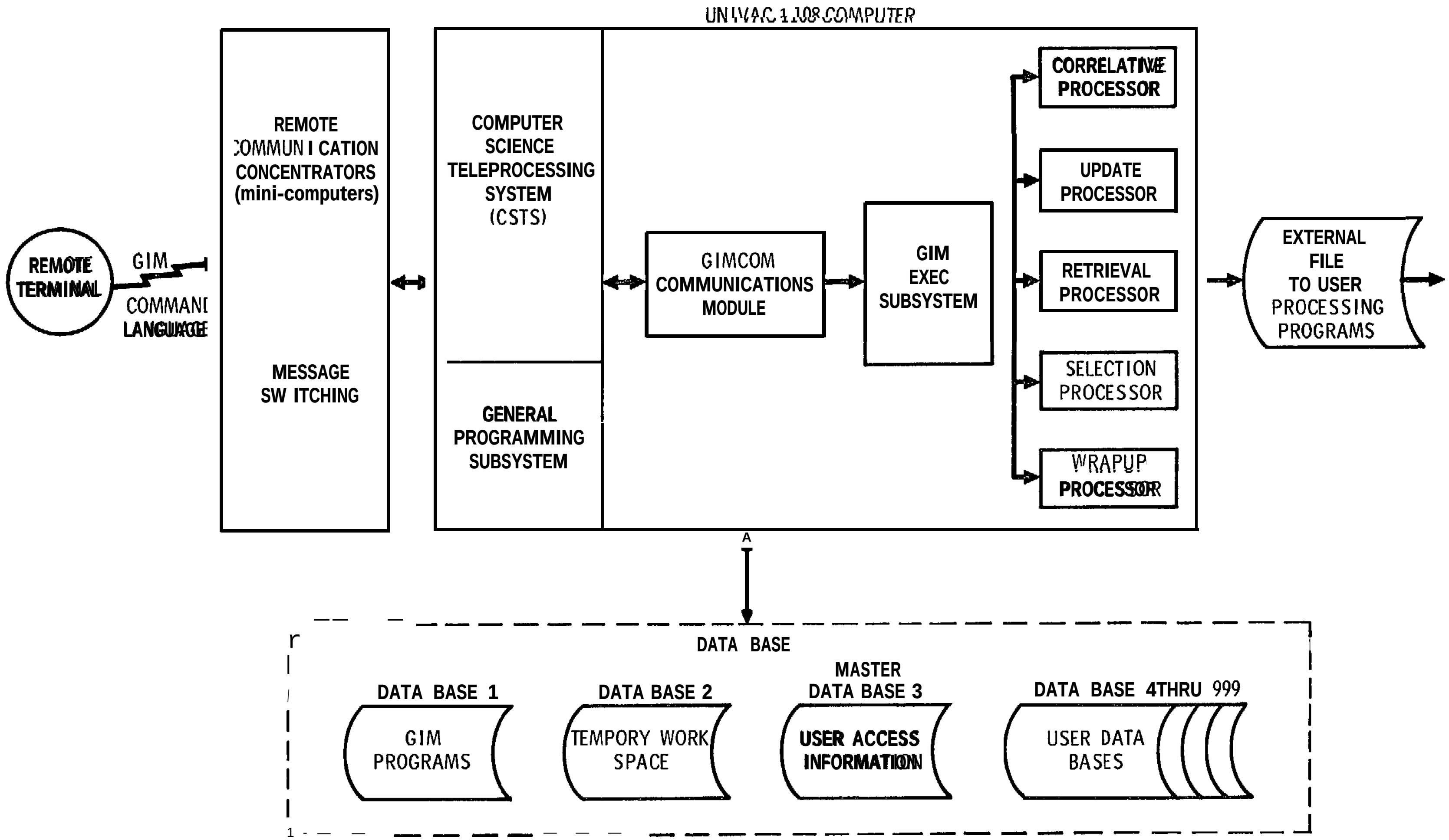


FIGURE 1-1. GIM OPERATING UNDER CSC'S INFONET

1.2 User Language

Requests for GIM activity are submitted by the user in the form of English-like statements. The GIM preprocessor analyzes the syntax of the statement and resolves each element of the statement into a system identifiable component. Verbs, modifiers, connective, and file names are resolved from the master dictionary. The dictionary for the named file is then used to resolve remaining elements, such as parameter or field names. If the elements of the statement remain unresolved after this analysis, an error message is issued, and the statement is terminated.

While performing this analysis, GIM reduces the statement into a processing string, based on the directives implicit in the file dictionary and the user's request. Processors such as Correlative, Update, Retrieval, Selection and Wrap-up will then be exercised based on the logical path required to perform the desired task. (The correlative processor allows data interrelationships to be expressed through predefine operators in the dictionary, eliminating the need for storing data in more than one place. Update, Retrieval, Selection and Wrap-up processors handle data base manipulations functions.)

As the various processor modules are executed, a transaction vector(s) is built, consisting of the new record(s), image(s), or an output message. These vectors are then processed by the Wrap-up processor which handles all data base updating. Transaction vectors, as well as others containing information such as the time, date, user identification, and the input statement, may be optionally written to the HISTORY file for subsequent operations and data base analysis or for recovery processing (in case of a damaged data base).

1.3 Functional Commands

The functions of GIM are evoked through the use of the GIM command language statements (trans actions). These transactions are of four gene ral types: data base description, file creation, data base maintenance, and data base interrogation. Specific s ys tern features include: valida - tion of input, selective retrieval, checkpoint capability (provides a means for "backing up" the data base and a means for restoring it in the event that it is invalidated through system failure), transaction history maintenance, usage statistics compilation, resident auto-load feature for direct automatic update of data, the capability to manipulate data upon entry and retrieval, and the capability to relate data internal to the data base.

1.4 GIM Data Base Content

A GIM data base always resides on a direct-access storage device to facilitate the rapid response to incoming queries. (Tape files are permitted, but not recommended.). Physically, the data base storage is divided into fixed-length records. Logically it consists of files, variable length fields, and logical records comprising the master data base dictionary and GIM system files. Data base security is provided by password locks down to the data element level.

1.5 Data Base Manipulation

When updating a dictionary or data file, all the user needs to do is identify the file, the logical record (by the "key" field in the record), and the field in which an addition or change is to be made. Users are encouraged to do file updating in the batch mode wherever possible. Updates will lock all other users out of the data base during processing of the update.

CSTS files, external to the GIM data base, may be created in a variety of formats for proces sing by applications programs written in FORTRAN, COBOL, and assembly language. They may also be used by the GIM Generalized Report Capability (GRC) which enables a user to design and produce reports according to his own format specifications.

2.0 GIPSY (UNIVERSITY OF OKLAHOMA)

The General Information Processing System (GIPSY) is a sophisticated information handling tool developed at the University of Oklahoma. The system illustrated in Figure 2-1 provides facilities for the preparation, use, and maintenance of information collections composed of numeric, codified, or natural language data. The modular system has found applications in a wide variety of fields including: medicine, government, research and education. Installations using the CIPSY System are: USGS, University of Missouri Medical Center, Texas Institute of Research and Rehabilitation, and NOAA. Under GIPSY, communication between the user and his data base is established in a clear, concise, English-like language. It is especially useful during early stages of project development because it allows for the repeated testing of many file arrangements without reprogramming.

2.1 Computer Environment

The minimum computer environment necessary for GIPSY processing includes IBM 360 or 370 series processor with a minimum of two disk drives. The operating system under which GIPSY functions is IBM OS, and the source language is 360 Assembler. Terminal types that will operate with GIPSY are IBM 2741 compatible terminals or any conventional teletype terminal. GIPSY operates in both the batch and teleprocessing modes.

2.2 GIPSY Files

Six programs are used to build and maintain GIPSY files. (See Table 2-l). The file system has three parts : (1) a dictionary that defines valid entries in a record, (2) a dynamic address list called the Selected Records File (SRF), and (3) the data records themselves, all of which are stored on direct access devices. Each entry of the dictionary consists of a reference label, an output format control field, and a definition of data contents. The SRF is created when a search of the data base is requested.

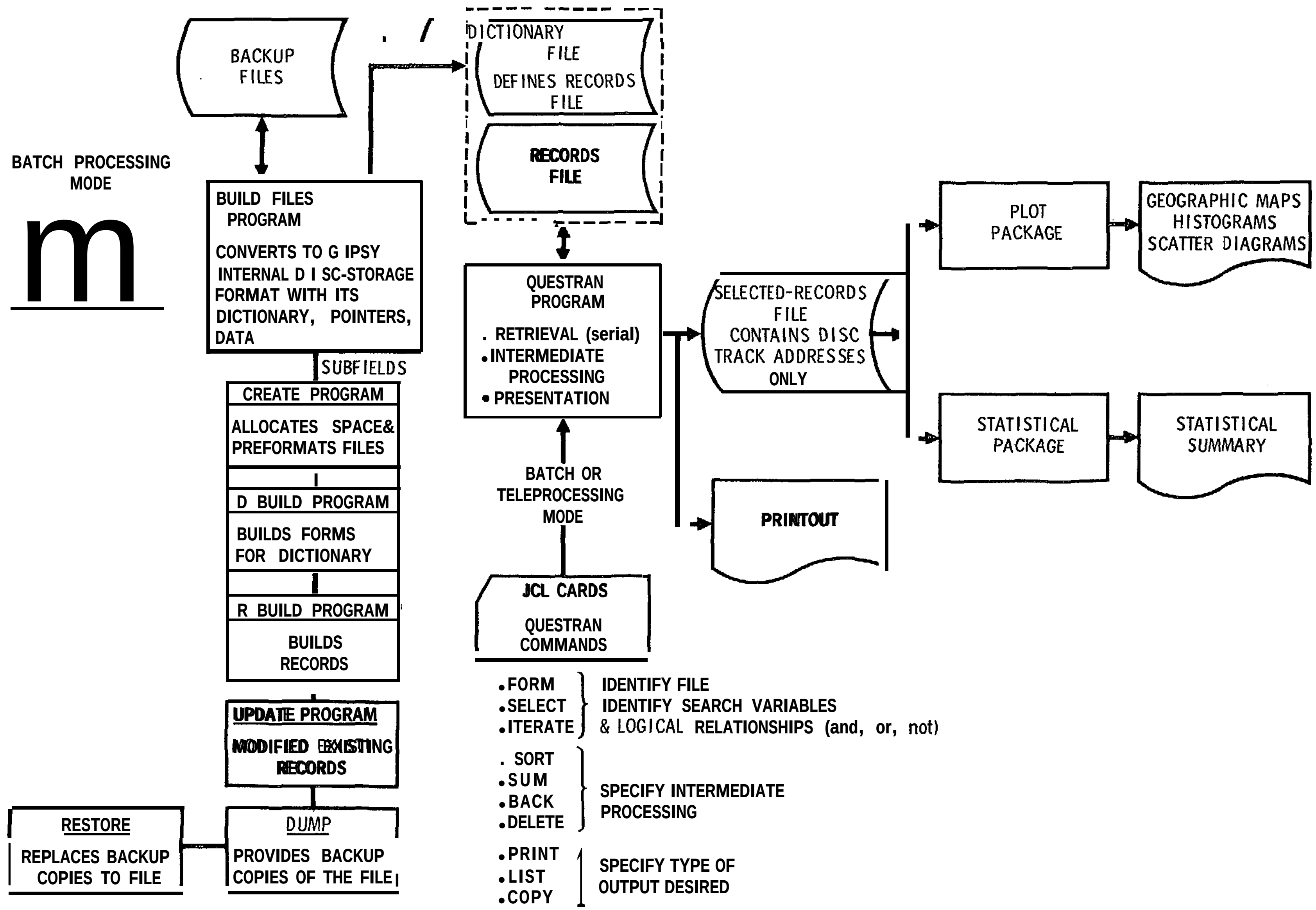


FIGURE 2-1. GIPSY

TABLE 2-1. GIPSY FILE MANAGEMENT PROGRAMS

PROGRAM	FUNCTION
CREATE	Allocates space and preformats the files.
DBUILD	Builds forms for the dictionary.
REBUILD	Builds records.
UPDATE	Modifies existing records by adding, deleting, or modifying data elements.
DUMP	Provides backup copies of the file.
RESTORE	Replaces backup copies to the file.

It contains the disk track addresses of the records retrieved, not the actual records. The Records File contains the actual data records, no one of which can exceed 32, 000 characters. Since records may overflow from one track to another, all available space on a disk is utilized. Multivolume files exceeding one disk pack are permitted. Each file record has a directory describing the labels and lengths of data items in the record. The directory limits searches to the pertinent parts of a record and allows the search program to bypass records that do not contain the requested data elements.

2.3 Retrieval Procedures

The GIPSY retrieval philosophy is as follows: move from a large, slightly relevant data cone ction to a small, highly relevant one through a user controlled retrieval process, evaluate each succes sive subset, and finally, process output and reports. The GIPS Y command language, QUESTRAN (QUEStion Translator), allows the user a command repertoire to search and retrieve data, to perform intermediate processing, and to specify the type of output he requires. Table 2-2 lists the QUESTRAN commands and their functions. The command structure is open ended and special purpose processing commands may be added to QUEST RAN as needed.

A GIPSY search is an iterative procedure that enables the user to make decisions about the course of his search at various points during its exe cution. The logical relationship can be expressed between search variables in a LOGIC statement by the Boolean ope raters AND, OR, and NOT. At the completion of a search, GIPSY displays the following search statistics: the number of records searched; the number of records selected; the number of records satisfied for each search variable; or, the number of records satisfied for each combination of search variables that were identified through additional logic statements. At this point the user can print the results of the search; cancel the results and formulate a new search; increase the specificity of the search by adding more terms, or revert to a previous broader-level search.

TABLE 2-2, QUESTRAN COMMANDS

COMMAND	FUNCTION
SELECT	To indicate a search is to be made on the entire data base.
ITERATE	Denotes a search on a selected subset.
SORT	Used to arrange a selected subset into any user defined sequence.
SUM	Operates on numeric data to produce a frequency count, total summation, range and average value.
PRINT	Outputs the entire contents of a record according to a user defined format.
LIST	Allows the user to selectively identify an entry or entries within a record to be output.
COPY	Produces a fixed field, fixed record length output. Output may be printed or used as input to processing programs not contained in the GIPSY system.
BACK	Returns the system to any previously selected subset for subsequent processing.
HELP or????	Will list the command repertoire of GIPSY with a general definition of each command's function.
FORM	Identifies the data base to use,
DEFINE	Supplies a printed listing of the items contained in a search or print form.

3.0 IMS (INTERNATIONAL BUSINESS MACHINES)

IBM's Information Management System (IMS) was originally developed as a joint venture between IBM and the North American Rockwell Company in the mid-1960's. They produced I-MS-l. The system was subsequently released as a program product with full IBM support in September of 1968. After a number of intermediate releases, IBM arrived at Version 2 of IMS early in 1973 and the next step in IMS development occurred when IBM announced IMS/ VS (IMS for vistual storage) for availability under OS/VS1 and OS/VS2 in February 1974, and under OS/VS2 with multiprocessing support in July 1974. It is estimated that there are currently over 400 users.

3.1 System Versions

IMS-2 and IMS/VS each come in two basic forms: Data Base (DB) system only, and Data Base s ys tern with Data Communications feature (DB/DC). While the DB system handles input job streams by batch scheduling, the DB/DC system is transaction-oriented and schedules work based upon input mes sages. The DB/DC concurrently supports both batch and on-line applications.

3.2 Hardware Requirements

IMS-2 operates on System/360 and 370 computers requiring a minimum of 128K bytes for DB and 256K for DB/DC under MFT. Under MVT, the system required 256K for batch-only DB and 512K for DB/DC. Under OS/VS, minimum real storage requirements for DB are 384K for OS/VS1 and 512K for OS/VS2. For DB/DC, the requirements are 512K and 768K, respectively. In addition, the DB system requires one 7 or 9 track magnetic tape unit and 740 cylinders of 2311 disk for program storage and work space. The DB /DC system requires an additional non-switched 1050 Data Communication System or 2740 Communication Terminal and two 9-track tape units. IMS/VS will operate on SYSTEM/370 Models 145, 155-11, 158, 165-11 and 168. In addition to the user's application programs, IMS/VS itself requires a minimum region or partition size of 90K for DB only, and 400K for DB/DC. Also required are an OS/VS1 or OS/VS2 system console, at least one 2400 or 3400 series 9-track tape unit, and direct-access space for system libraries and working storage.

3.3 Generation and Access Capabilities

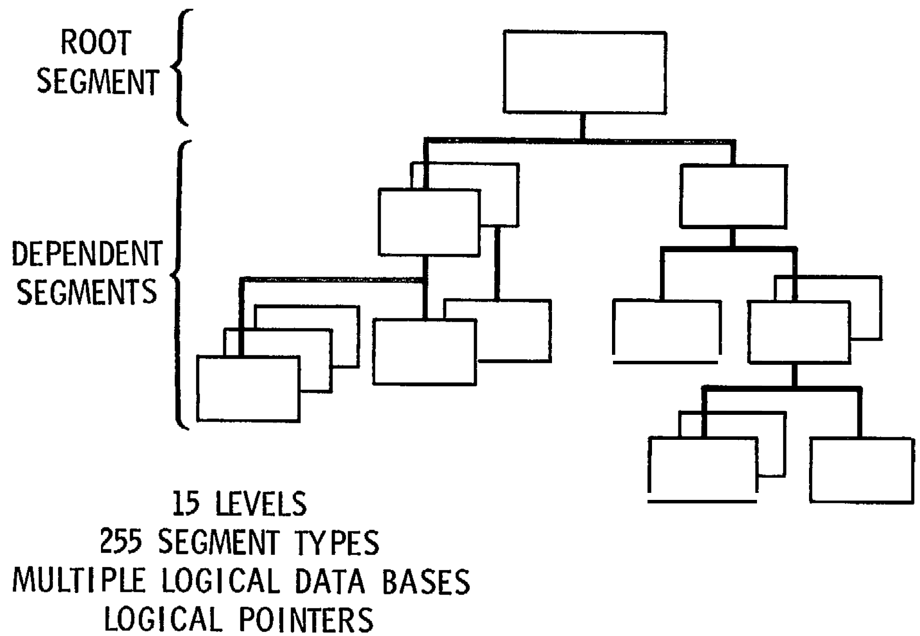
IMS provides the capabilities for generating and accessing a data base with automatic cross -referencing among data records. With the DC feature, on-line inquiry with IQF (Interactive Query Facility) or GIS/VS (General Info rmation System) and batch inquiry with GIS or GIS / VS are available. There are two data communications monitors to choose from - the Teleprocessing Option of IMS, or CICS. IQF is a basic query language (English-like and free-form) that offers the capability for on-line retrieval and display of data in an IMS data base. The language includes a Boolean logic capability.

3.4 Data Base Structure and Manipulation

Each IMS "physical" data base is organized in one of four hierarchical or tree-type structures. (Hierarchical sequential, hierarchical indexed sequential, hierarchical direct, hierarchical indexed direct). These are illustrated in Figure 3-1. The use r views the physical data through a "logical" data base description that allows sophisticated security precautions and data relationships to be expres seal. The logical data base represents one of IMS's best assets, as it facilitates data independence and simplifies program logic. Data stored in multiple separate physical data bases can be treated as if it were logically part of one data base. IMS does support inverted data structures.

A full complement of IMS utility programs is provided to des tribe the data base structure, create the data base, reorganize the data base, recover and reconstruct data (checkpoint/restart capability), specify security control, and analyze the system workload.

IMS supports data base access methods VSAM, ISAM, OSAM, BSAM and SAM. Application languages COBOL, PL/ 1 and assembly language are supported. The report generator capability is GIS/VS or GIS-2.



SYSTEM	IMS-II
COMPANY	IBM
CORE	90K (MIN)
BASIC STRUCTURE	HIERARCHY
ORGANIZATION METHODS	HSAM HDAM HISAM HIDAM
COST LEASE	550
PURCHASE	N/A

FIGURE 3-1. IMS SCHEMATIC

4.0 SYSTEM 2000 (MRI SYSTEMS)

MRI's SYSTEM 2000 is a flexible information update and retrieval system with a wide range of practical applications. It has been implemented on IBM System/360 and 370, UNIVAC 1106, 1108, and 1110, the CDC 6000 series and Cyber 70 computer systems. SYSTEM 2000 data base structure and file handling capabilities are illustrated in Figure 4-1.

4.1 Data Base Structure

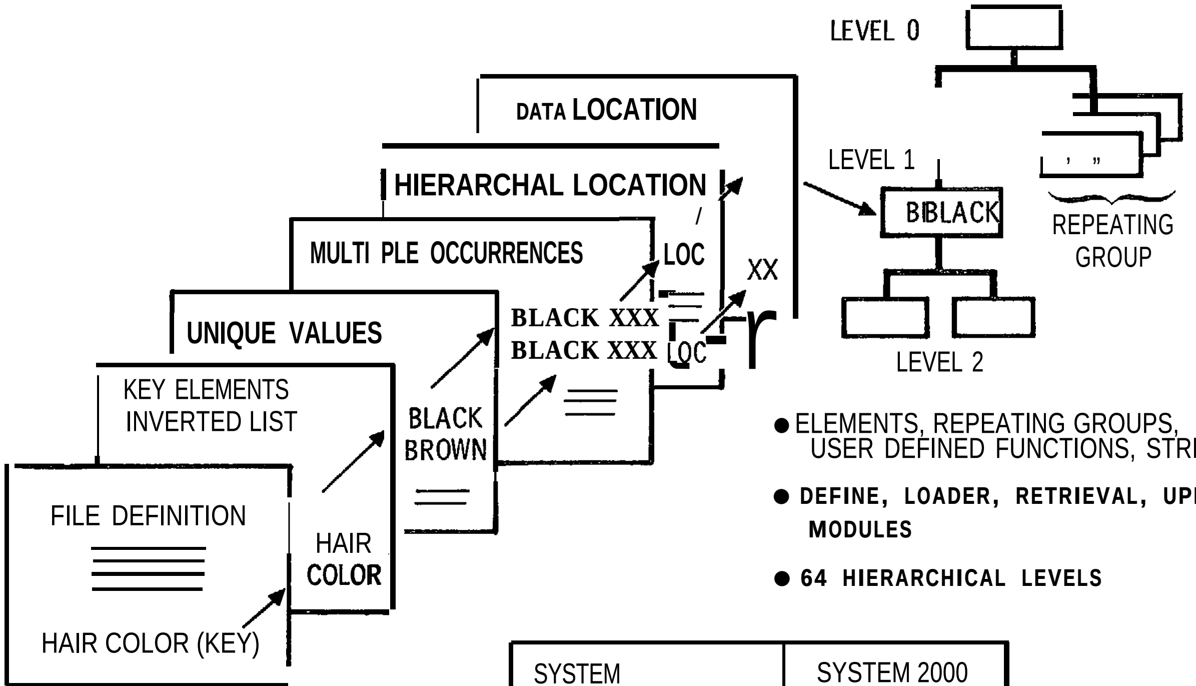
As a generalized data base management system, SYSTEM 2000 uses partially inverted tree structures for efficient on-line and batch data processing. Tree structures containing up to 64 hierarchical levels can be accommodated. Pointers, in the form of indirect address references used to physically locate data items. When combined with a significant amount of sequential storage, list structures can provide very effective overall data base organizations.

SYSTEM 2000 uses this partial inversion approach and allows the use r to determine the quantity of inversion that will be used. The more inversions that are applied, the greater the potential for quick retrieval, however, excessive inversion application slows down the processes of file creation, updating, and modification. Thoughtful definition of the data base can greatly reduce both time and storage overheads in SYSTEM 2000 applications.

4.2 Data Base Handling

Although efficient data base servicing is accomplished through the application of SYSTEM 2000 inverted tree structures, the system also has the capability of handling files with other structures.

A sequential file feature allows the user to access data bases residing on sequential tapes and disks. Retrievals are accomplished by selecting data from the inverted files on disk plus one pass of the sequential files to pull off any other needed data.



- ELEMENTS, REPEATING GROUPS, USER DEFINED FUNCTIONS, STRINGS
- **DEFINE, LOADER, RETRIEVAL, UPDATE MODULES**
- **64 HIERARCHICAL LEVELS**

SYSTEM	SYSTEM 2000
COMPANY	MRI SYSTEMS
CORE	130K
BASIC STRUCTURE	INVERTED
ORGANIZATION METHODS	SEQUENTIAL LIST
COST LEASE	N/A
PURCHASE	35,000 TO 135,000

FIGURE 4-1. SYSTEM 2000 SCHEMATIC

An INDEX capability of the system allows the changing of any element from non-key to key without causing a complete reload of the data base , thereby alleviating the need for excessive file inversions.

The LINK feature allows the user to establish logical relationships among occurrences of repeating group data. Retrieval commands can then be automatically cascaded to facilitate logical associations between different data files or different portions of the same file. The links are symbolic rather than physical, therefore, associated files can be reorganized, restored, and accessed independently.

The IMMEDIATE ACCESS feature permits immediate direct updating of data base entries through an on-line keyboard or batch input. However, since the on-line keyboard process is restricted to some extent by the speed of the operator, users are urged to input large amounts of data via batch input and reserve the on-line capability for minor updates, data retrieval, and analysis processing.

The system also provides an audit trail facility which preserves a machine-legible file of the updating transactions and can be used with an archive copy of the data base for audit or backup purposes.

4.3 User Interface Language

SYSTEM 2000 provides a user oriented English-like language with which a non-programmer may query a multi-user information data bank for retrieval, updating, or analysis processing. The system supplies a complete set of easily-understood diagnostic mes sages and is highly suited for interactive or remote batch use from keyboard terminals.

4.4 Application Program Interface

SYSTEM 2000 has procedural-language interfaces for COBOL, FORTRAN, and (for IBM systems) PL/ 1, to permit user application programs to access the SYSTEM 2000 data base. Using the Multiple Thread feature, the system is completely re-entrant, allowing multiple simultaneous use rs to access a given data base uncle r multi-programming. During such access, requests are processed on a first-come, first-served basis, with suspension of retrieval during an update. These capabilitiess are particularly useful for environments where the imbedded retrieval language is desirable for fast responses, while a complex user process, that manipulates data, can operate on the data base during batch operations and can be performed concurrently with, or separately from, other interactive use.

4.5 Report Generation

A Report Writer feature satisfies user needs for standard report production. It enables the user to define and generate as many as 100 formatted reports from a single scan of the data base indices in either a batch or on-line mode. Only the data base indices which qualify the data needed for the reports are scanned thereby reducing the search time. Within each report, the user may specify headings and footings for each physical , page and logical section. The user also has the capability to specify insertion or deletion of characters in output, item inclusion, page ejection, and accumulation dynamically via conditional statements. Reports can also include items which are built from sums, counts, or arithmetic combinations of items.

4.6 Teleprocessing Capabilities

The SYSTEM 2000 teleprocessing capability interfaces to monitors such TCAM, MRI's TP2000, CICS, and others, which allow scheduling of a SYSTEM 2000 procedural language program or use of MRI's IMMEDIATE interactive language. The CICS interface supports IBM 2740, 2741, and 3270 terminals and includes terminal display paging and input editing features. Extensive diagnostics are provided by the system which help users through the natural and procedural language processes.

4.7 Hardware Requirements

On IBM computers, SYSTEM 2000 requires a 360/40 or 370/145 with a minimum of 256K bytes uncle r OS or OS/ VS. The Decimal and Floating Point features are required, as well as sufficient on-line storage for the data base(s) and scratch files. SYSTEM 2000 also runs under EXEC 8 on a UNIVAC 1106, 1108, or 1110, using approximately 32K words of memory, or under SCOPE or KRONOS on a CDC 6000 series or Cyber 70 computer, using approximately 18K words of memory.

APPENDIX F

GLOSSARY OF DATA BASE MANAGEMENT TERMS

GLOSSARY OF DATA BASE MANAGEMENT TERMS

ASSOCIATIVE RELATIONSHIP	A data relationship in which the entities are of the same type or value. An inverted file is an example of an associative relationship.
DATA BASE	The set of all information of interest to the user. A highly structured collection of data from a variety of functional areas that must be addressed or referenced in order to be useful. The essential basic element is the record, which may be fixed or variable in length and field content.
DATA BASE DESIGN	The complete specification of the data base for a system involves precise definition of the kinds of information to be stored in the sys - tern, the relationships of the various types of data to each other and to the system, and the physical organization of the information with- in the computer system.
DATA BASE STRUCTURE	The organization of the information in the data base which shows the established logical rela- tionships among the various types of data.
DIRECT ACCESS	A process in which a single record can be read from the file or written on the file with- out affecting any other records.
DIRECTORY APPROACH	An approach to file organization which in- volves having one or more levels or hier- archies of tables in which a record can be "looked up" on a particular key. The di- rectories themselves may be maintained in core, on a high-speed drum, or on disk.

FIELD	**The elementary data structure from which structures of all other types are ultimately composed. The principal attribute of a field is value which may be a number, a string of characters, a truth value, and so on. A** record attribute might be a name which is used to refer to the field.
FILE	A **file is a set of records. A file thus corresponds to a number of application entities such as people, wells, states, parts, projects, etc.**
FIXED LENGTH RECORDS	A record consisting of a set of fields each of which has a fixed number of storage positions.
FULL INVERSION	This is an inverted file technique in which all possible fields of a record are used as a key (each has a directory).
HIERARCHICAL RELATIONSHIP	A **data relationship in which the entities are of different type or value. Examples are a tree structure, matrix or ring.**
INDEXED SEQUENTIAL FILES	Files which have the property that the records within the file may be accessed either by the use of an index or in a sequential mode.
INVERTED FILE OR LIST ORGANIZATION	The files in the system which may be partitioned by grouping all those records together that have a particular value in a specific field in common. An inverted file is created by establishing a collection of subfiles consisting of all file partitions that are generated by grouping the records which have some field value in common. Usually, one inverted

file is established for each field which is desired as a major retrieval element in the system.

KEY	A **field or a set of fields which identifies a record. The key determines the order in** which the records are entered in the file, and it is used to find a record in the file that has a prescribed identifier.
LINKED LISTS	The concept of linking or chaining records together to form an associative relationship.
NETWORK STRUCTURE	A complex logical arrangement of data. There may be an arbitrary number of interconnections between data items.
PARTIAL INVERSION	An inverted file technique in which some of the fields of a record are used as a key.
RECORD	A collection of related data elements, items, or codes that are logically treated as a unit.
SEQUENTIAL ACCESS	A **process in which records must be read from the file or written on the file in sequential order.**
TREE STRUCTURE	A complex logical arrangement of data in which the re are no interconnections between branches.
VARIABLE DATA RECORDS	**Records characterized by this ability to hold different subsets of the same set of attributes for each occurrence of the record type. Variable data records niay or may not be of variable length.**

VARIABLE LENGTH RECORDS

Records having one or more variable length fields, or one or more fields or subordinate groups which vary in the number within the record.

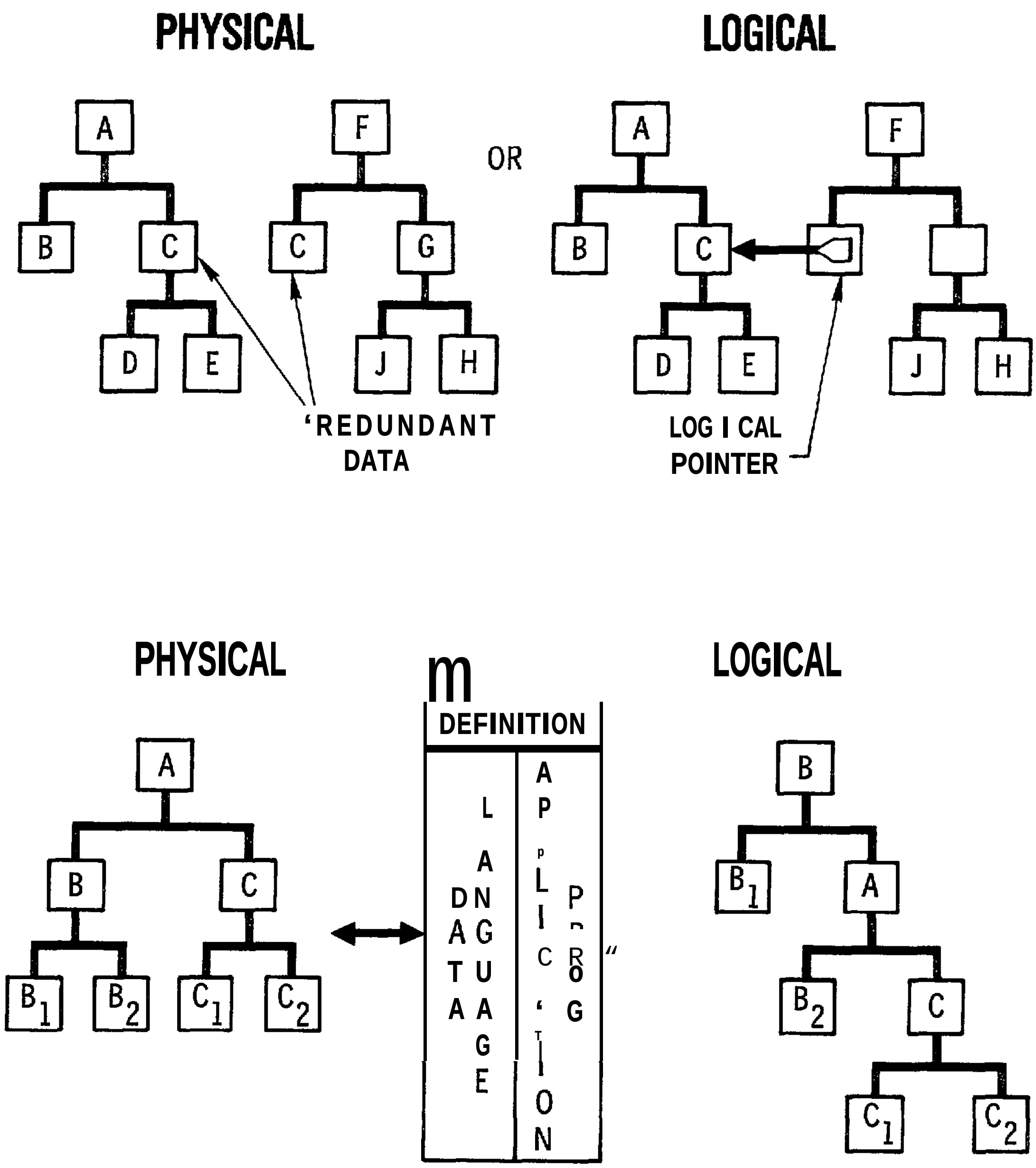
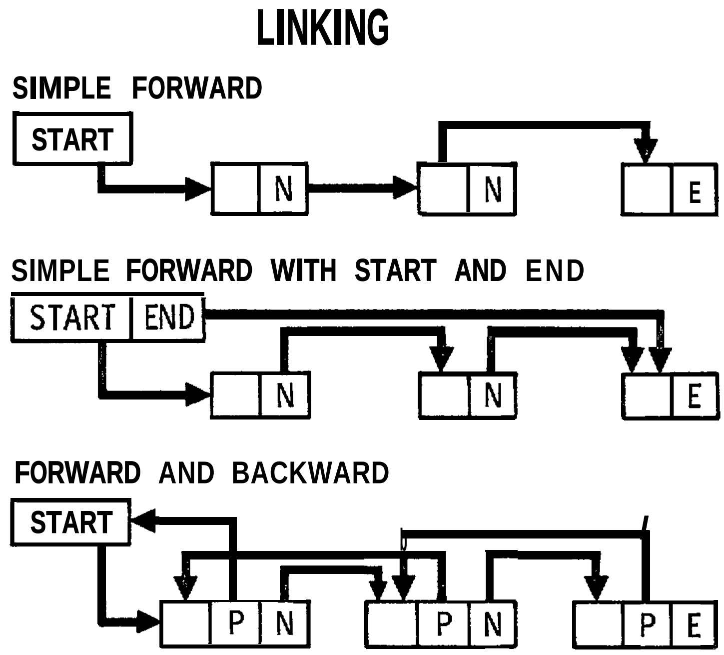


FIGURE 1-1. PHYSICAL/LOGICAL DATA BASES



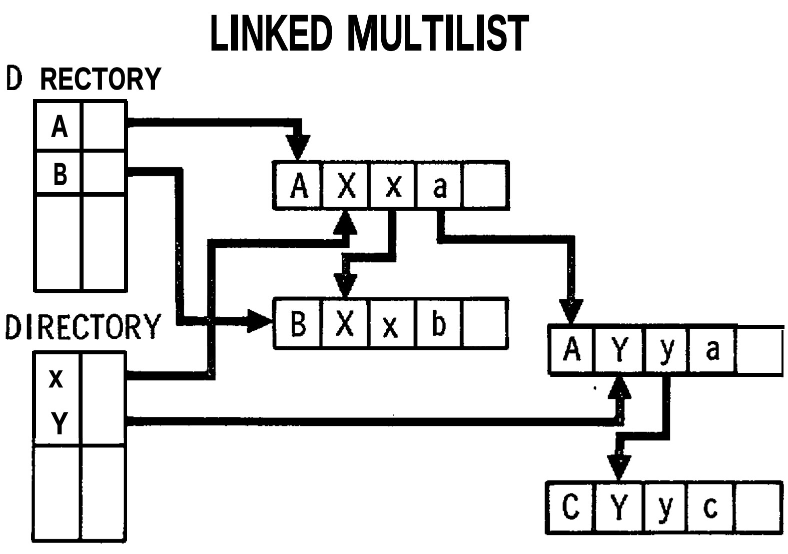


FIGURE 1-2. ASSOCIATIVE RELATIONSHIPS (1 of 2)

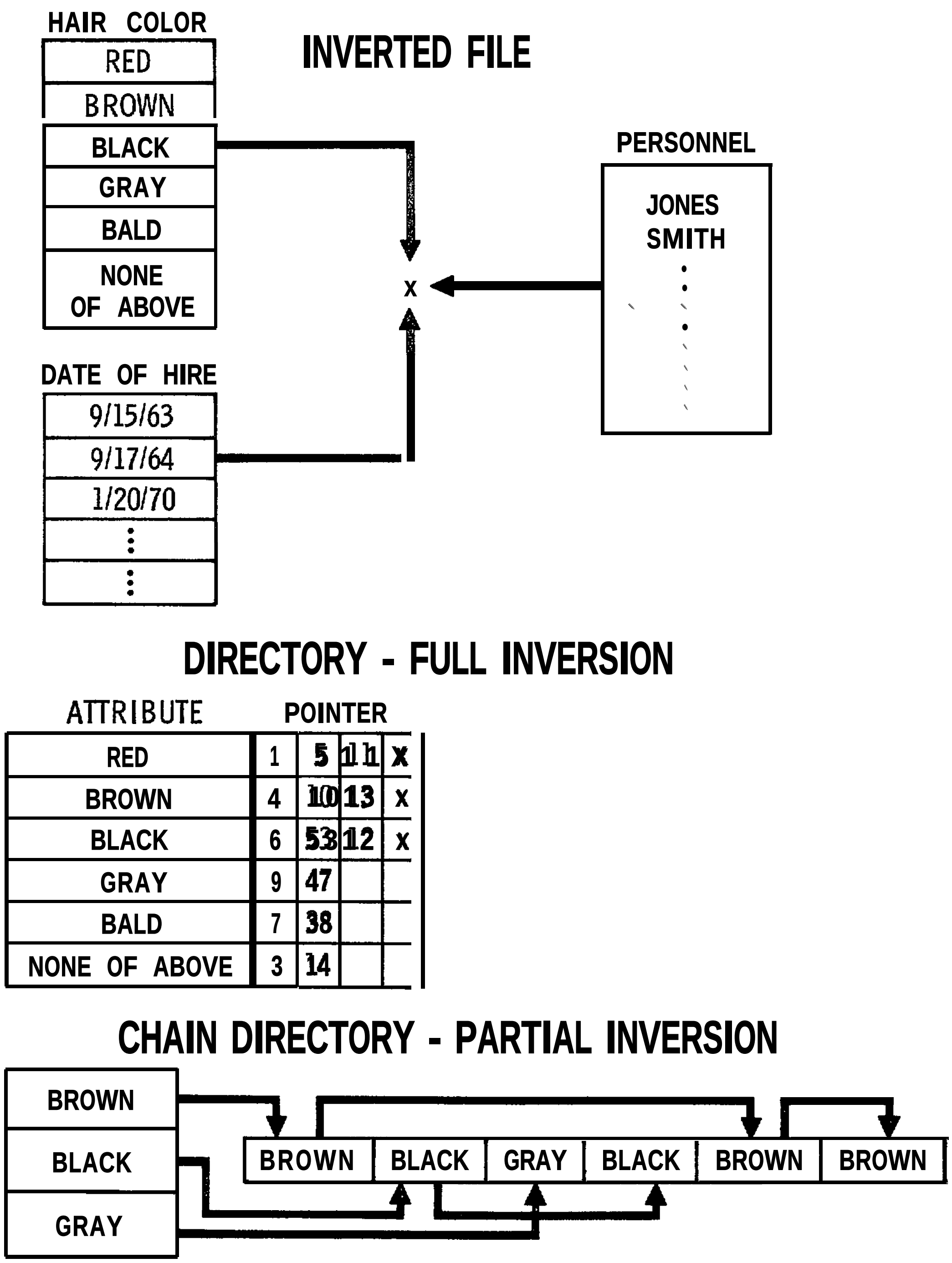


FIGURE 1-2. ASSOCIATIVE RELATIONSHIPS (2 of 2)

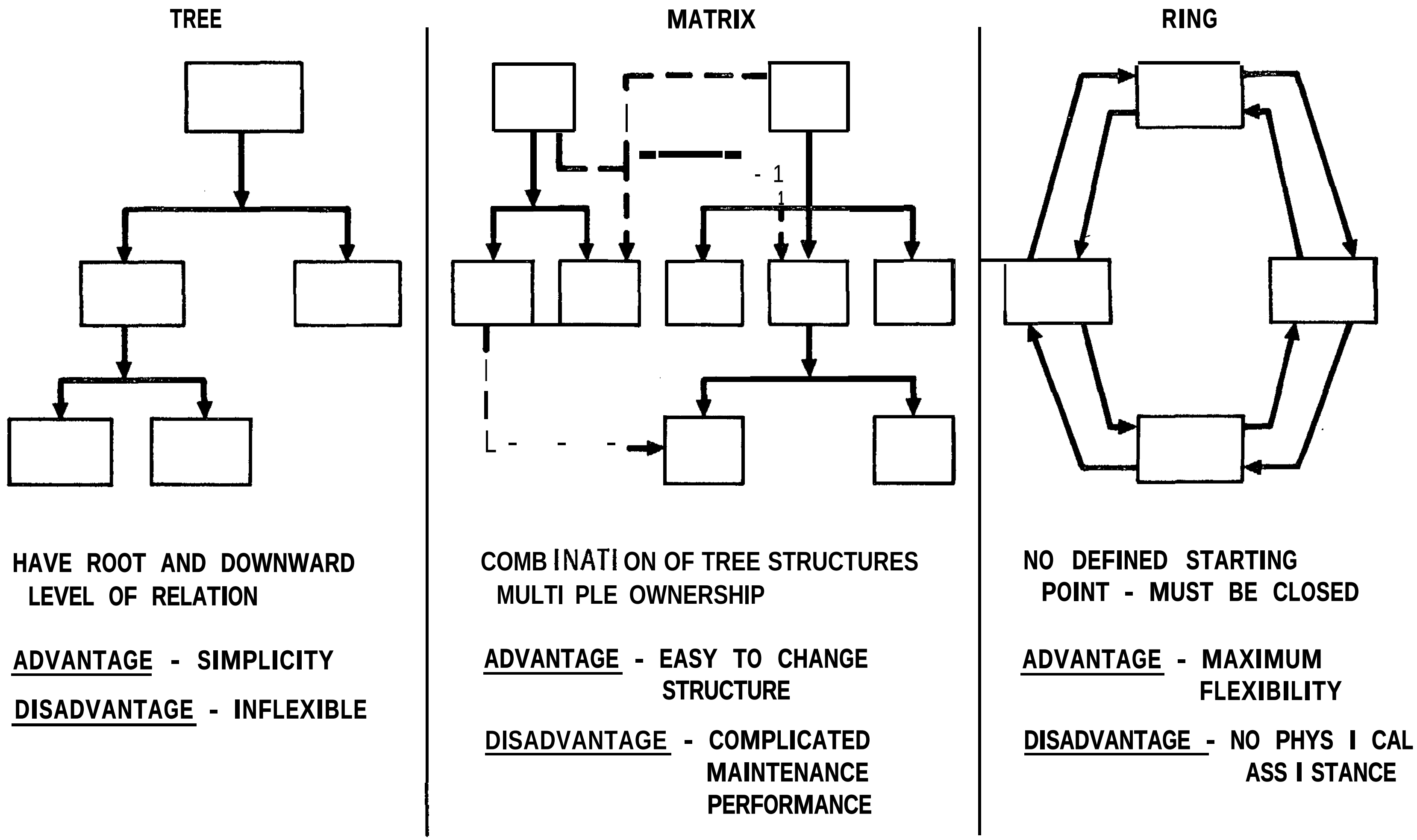


FIGURE 1-3. HIERARCHICAL RELATIONSHIPS

APPENDIX G

REMOTE-BATCH TERMINAL,

COMMUNICATIONS PROCESSOR SURVEYS

Reprints of published articles.

D. J. Theis and L. C. Hobbs. "Trends in Remote-Batch Terminals," Datamation, September 1, 1971.

and

D. J. Theis. "Communication Processors," Datamation, August 1973.

The combination of lower cost peripherals, communications equipment, and minis has led to cost-effective terminals that are beginning to offer an inviting alternative to in-house data processing

Trends in Remote -

The use of data terminals of all kinds is increasing rapidly. Contributing factors are more useful end-user application programs, standardized terminal equipment, and the development of specialize] user-oriented terminal equipment (e. g.. of F-track betting terminals in New York). The remote terminal market is expected to increase to over $1.5 billion per year by 1975, from under $500 million in 1970. One quarter of this will be represented by remote-batch terminals.

Remote terminals can be considered in the following major categories:

1. Keyboard/printer terminals (e.g., Teletypes)
2. Alphanumeric crt terminals
3. Smart terminals (also referred to as intelligent terminals)
4. Data collection and transaction terminals
5. Remote-batch terminals
6. Other types of terminals

With the advent of lower cost and greater availability of computer/communications utilities, the use of remote-hatch terminals becomes attractive to more and more small users who cannot justify their own data processing systems. Remote-batch terminals can be used in any type of application in which computers are needed for conventional scientific computing and business data processing. In such applications remote-batch terminals offer the user convenience by providing input. output equipment in his facility, while still permitting him to share the capability of a large central computer, thus providing very fast response and eliminating the need for taking data back and forth between the user's facility and a service bureau or central facility.

Basically, remote-hatch terminals are assemblies of input/output and peripheral equipment at the remote user's facility, connected via communication lines to a central computer at another location, In most systems of this type all computation and data processing is performed by the central computer with data read from input devices, such as those using punched cards or magnetic tape, at the remote-batch terminal and the resulting output provided at the remote terminal by output devices, such as card punches or line printers. To the user, the remote-batch terminal appears as a complete batch-processing computer facility with input/output, data processing, and storage capability. In fact, however, the data processing and a major portion of the storage is provided by the central computer while the I/O functions are provided by the remote-batch terminal.

Remote-batch terminals extend the facilities and capabilities of service bureaus by permitting their customers to input and output data in their own facility, while using part of the capability of a large. remotely located computer. This type of operation is frequently referred to as remote job entry. Remote-batch terminals are also applicable within a large company to permit serving different plants or divisions from a centrally located computer, which is larger and more cost-effective than any of the plants or divisions would be able to provide in their own facility.

Specific applications for remote-batch terminals include the following:

Scientific and Engineering: Engineering computation: scientific computation; statistical research; data reduction; simulation; operations research; and automatic program control (APT).

Business Data Processing: Payroll and labor cost distribution; inventory control; production control; market and sales analysis; ordering and invoicing; resources scheduling; and information]) retrieval.

Remote-batch terminals do not offer any signifi-

Batch Terminals

by D. J. Theis and L. C. Hobbs

cantly new type of computing 'capability as crt terminals and smart terminals do. Rather, remote-batch terminals offer convenience for the user in providing input/output equipment in his facility while still permitting him to share a capability more than' he could justify in a local on-site computer. For example, the user of a remote-batch terminal may have in his terminal only a card reader, a card punch, and a medium speed line printer, yet he can have at his disposal for short periods of time the full use of a large computer with 128,000 words or more of core storage, large disc files, magnetic tape units, and other expensive peripheral equipment.

Survey guidelines

The term remote-batch terminals conceivably could he applied to equipment such as the $750 Teletype (which has a 10-character-per-second keyboard printer) and to a multi-million-do llar computer system linked remotely to another computer system, if these are used in an on-line batch mode. For our purposes, the term is restricted to terminals designed to provide *typical* on-line batch processing input/output at a remote site connected to a central host computer, usually over communications lines. The typical input/output equipment is a card reader and line printer. Several other types uf peripheral equipment may be included, such as magnetic tape units, crt displays, card punches, paper tape reader/punch, plotters, discs, and cassette/cartridge tapes. The major portion of the cost of reroute-batch terminals is in the peripheral equipment. The minimal requirements used to select remote-batch terminals for inclusion in this survey for a standard remote-batch terminal are as follows:

1. Input device: card reader-100 cpm
2. Output device: printer-120 lpm, 120 cols
3. Data set interface compatibility (EIA 232 specifications) to operate both input and output devices concurrently.
4. Remote-batch terminal to operate "off-the-shelf" with at least one computer/operating system configuration.
5. Optional capability for some other devices, such as card punches, magnetic tape units, crt displays, etc.

With the above guidelines a survey of remote-batch terminals is presented in Table 1 (which fol-1osvs on pp. 22-24) with the basic equipment features grouped as follows:

1. Input device(s)
2. Output device(s)
3. Communications interface
4. Controller configuration
5. Optional features

Excluded frnm this survey are stand-alone computer systems that may he implemented as terminal systems (e.g., IBM 360/20, Univac 9300, GE 430),

The purchase and rental prices shown, which have been supplied by the manufacturers, are intended to include all the equipment necessary on the remote end nf the communications link (except the modem) to make the remote-batch terminal fully operational.

Types of remote-batch terminals

The major approaches to remote-batch terminals are:

Simple terminals with hard-wired control and I/O equipment, and

Terminals including a minicomputer for stored-program control and preprocessing, with I/O equipment plus other peripherals such as a disc

ᴵanufacturer/Model No.	Atron Mohawk Data Sciences 501-74/501-76	Atron Mohawk Data Sciences 501-78	Atron Mohawk Data Sciences 501-80/501-90	Atron Mohawk Data Sciences 501-84/501-88	A**on Mohawk Data Sciences 501-96/501-98	Badger Meter (Noller) DTS-100	Burroughs 1102/1103	Burroughs 1202/1203	Burroughs 1101/1201	California Computer Products 900 RJE	COMPA… Corp. 2400	Compat Corp. 88-23
ˀnput Devices												
Card Reader, cpm (80 cols)	300/1000	300	300	300	300/1000	400	200	200	—	300	300	300
Keyboard Printer (char/sec)	—	—	—	ASR-33	ASR-33	ASR-33	Teleprinter (15)	Teleprinter (15)	Teleprinter (15)	Teleprinter (1030)	Teleprinter (30)	Selectric (15)
Optional Paper Tape Reader (char/sec)	—	—	—	—	—	—	—	—	500 or 1000	300	—	300
ʾutput Devices												
ˌine Printer, lpm (cols)	300/1250 (136,160)	300 (136)	300 (136)	300 (136)	300/1250 (136, 160)	300 (132)	300 (120)	300 (120)	300 (120)	242-11 ° (136)	250 (136)	600 (132)
ˀptional Card Punch, cpm (80 cols)	—	—	—	—	—	100	200	100	—	—	100	—
Optional Paper Tape Punch (char/sec)	—	—	—	—	—	—	—	—	100	—	—	—
ˀther Optional Input/Output Devices ˀvailable												
Magnetic Tape—7 or 9 tracks	✓	✓	✓	✓	✓	✓				✓	✓	✓
CRT-Keyboard						✓		✓	✓	✓	✓	
Disc	✓	✓	✓	✓	✓					✓		
Plotter										✓		
(Business, Scientific, both)	B	B	B	B	B	both	B	B	B	S	both	B
	up to 4800	up to 50K	up to 100K	up to 4800	up to 50K	up to 9600	up to 4800	75 to 4800	75 to 4800	up to 2400	up to 9600	up to 2400
Code Compatible												
ASCII		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
EBCDIC		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
XS-3	✓	✓				✓	✓	✓	✓	✓		
SBT		✓						✓		✓		✓
6 BIT TRANSCODE		✓	✓					✓		✓		
ˀontroller Type												
ˀrogrammable, Hardwired	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	—	Programmable
Memory/Buffer Size (chars)	8K	8K	4K	8K	8K	4K	8K	8K	8K	—	—	4K
ˀonthly Lease, 1 year, ˀot incl. maintenance	$995/$1,655	$1,155	$765/$995	$1,145/$1,055	$1,115/$1,715	$1,290	$1,163/ $1,343	$1,726/ $1,906	$1,023/ $1,586	UR	$880 (3 yr lease)	$740 (3 yr lease)
ˀncluding card reader, ˀne printer, and controller)	$35,450/ $64,780	$40,150	$34,130/ $35,450	$41,470/ $38,950	$28,950/ $66,790	$49,529	$53,760/ $62,160	$78,240/ $85,680	$46,800/ $71,560	UR	$30,000	$29,600
ˀpecial Features/Options	Univac 1004 replacement; message compression and retransmission	Multi-function communications channel option	2780/2780-1 replacement. IBM 2701 and 2703 compatible	Compatible CDC 200 Users Terminal	Compatible 360/20 work station (use BSC mode to 360 HASP)	Compatible with 1004, 2… or User 200 terminals via applications software	Automatic dial out, single line control, 1103 price includes CP	Price includes 16 line multiplexor and 16 Synch/asynch adapters. 1203 price includes CP	Model 1101 price includes single line control. Model 1201 includes 16 line multiplexor and 16 adapters	Graphics CRT Terminal. Scientific applications	—	Price includes Com file Memory System, Storage 64KB, random access 0.5 seconds

ˀodem equipment optional

ˀR upon request

Table 1

Manufacturer/Model No.	Computer Communicatioi Inc. cc-36	Control Data Corp. 200 User Terminal	Control Data Corp. "7s3"	Data 100 Corp. Model 70-1	Data 100 Corp. Model 7S	Data Computer Systems, Inc. CP-4B	Eldorado Electrodata Corp. 1268	HETRA T-series	Honeywell 244112442	Honeywell (Gen. Elect.) 105 RTS	IBM 2770	IBM 27S0
Input Devices												
Card Reader, cpm (80 cols)	300	333	1200	300	300	300	400	400	00	300	00	00
Keyboard Printer (char/sec)	CRT-key board	CRT-keyboard	CRT-keyboard		Teleprinter (10)	Teleprinter (10	Selectric (15)	Selectric (15)			ielectric (15)	
Optional Paper Tape Reader (char/se				300	300	600					120	
Output Devices												
Line Printer, lpm (cols)	300 (132)	300 (136)	1200 [136}	300 (132}	300 (132)	300 (132)	135		00 120)	250 (1 20)	00	00
Optional Card Punch, cpm (80 cols)				200	200	100	75	60	00	100	30	
Optional Paper Tape Punch (char/sec				75	75	240					20	
Other Optional Input/Output Devices Available												
Magnetic Tape—7 or 9 tracks					✓	✓	✓	✓				
CRT-keyboard	Standard	Standard	Standard		✓	✓	J	✓		✓	✓	
Disc						✓	✓	✓				
Plotter		✓				✓						
Application Orientation (Business, Scientific, both)	both	both	both	both	both	both	both	B	oth		both	both
Communications Characteristics												
Transmission rates (bps)	up to 50K	2000 to 4800	50K	2000 to 9600	2000 to 9600	2000 to 9600	up to 9600	UP (0 9600	'300 to 4800	2000104800	up to 4800	up to 4800
Code Compatible												
ASCII	✓	✓	/	✓	✓	✓	✓	✓	'	✓	✓	/
EBCDIC				✓	J	✓	✓	✓			✓	/
X5-3												
SBT				✓	✓							
6 BIT TRANSCODE												/
Controller Type												
Programmable, Hardwired	Hardwired	Hardwired		Programmable	Programmable	Hardwired	Programmable	Programmable	Hardwired	Programmable	Hardwired	Hardwired
Memory/Buffer Size (chars)			4K	1000		800	4K	8K	100	4K		
Monthly Lease, 1 year, not incl. maintenance	$1,175	$750	$2,345	$810	$1,149	5900	$700	$875 (3 yr lease)	$1,080/ $1,185	$1.145	S600	$875
Sale Price* (including card reader, line printer, and controller)	$39,900	S25,000	$97,400	$29,000	S43,890	$36.000	$17,050	$30,000	$43,890/ $48.090	$45,600	$26,000	$38,41 o
Special Features/Options	Price includes T' display and controller. Same terminal with nonimpact printer 300 cps, 80 char/line is $23,900. Light pen option.	Price includes CRT display and controller. Partial trans. mit capability std. PT Reader! Pu rich, plotter options.	4KB memory expansion in programmable terminal. Up to 4 line printers cap. ability in terminal.	Compression techniques and dual modem switch available 400 or 600 lpm primers available.	Dual data set option. Compatible CDC 200, IBM 2780. & Univac DCT 2000.	Full trans. parency. Auto. matic answering data compression Mark sense card reader option	Standalone configuration available.	Price includes modem inter-face adaptor. Data compres-sion, auto answer and turnaround. and multiple record trans. mission.	2780 compatibl Model 2442 price includes CP.	Message compression	Automatic answer, security identification, 1255 MIC reader. Model 50 magnetic data inscriber options	Multiple record transmission, automatic answer

G-4

*Modem equipment optional

Table 1-a

ꞁanufacturer/Model No,	M & M Industries Inc. 515/560	M & M computer Industries Inc. 565/580	RCA 8740-8741	Remcom- Tracer Data Systems 2780	Control Data Corp. DCT-132	Unitech Inc. UT-1	Univac DCT-2000	University Computing Co. COPE 30/ COPE 32	University Computing Co. COPE 34/ COPE 36	University Computing Co. COPE 38/ COPE 41	University Computing Co. COPE 45/ COPE 1225	Xerox Data Systems 7670
ıput Devices												
Card Reader, cpm (8O cols)	300/800	300	300	600	300	400	200	200	300	600	1500/300	'00
Keyboard Printer (dar/see)	Teleprinter (10)	Teleprinter (10			AS R-33	ASR-33		ASR-33	ASR-33	ASR-33	ASR-33	
Optional Paper Tape Reader (char/se	625	625				300	300	500	500	500	300/NA	5
ıtput Devices												
ıne Printer, lpm (cols)	135/1800 (132)	245101100 (132)	300 (132)	400 (132)	300 {132)	600 (136)	250 [80)	360 (132, 1361	360/480 (132, 1361	480/ 1250 (132.136)	1250/300 1132,136)	50 128)
ıptional Card Punch. cpm (80 cols)	275	275			100	60	75-200	40-200	90-200/300	90-200	90-200	
ıptional Paper Tape Punch (char/se	110	110				150	110	150	150	150	150/NA	.
·her Optional Input/Output Devices vailable												
Magnetic Tape–7 or 9 tracks	✓	✓				/		✓	✓	✓	✓	
CRT-keyboard	✓	✓	✓		✓	/						
Disc	✓	✓				/						
Plotter	✓	✓				/		✓	✓	✓	✓	
ɔplication Orientation (Business, Scientific, both)	both	both	B	ɔoth	both	ɔoth	B '	both	both	both	both	ɔot h
ommunications Characteristics												
Transmission rates (bps)	up to 50K	up to 9600	UP to 9600	1200 to 9600	Up to 4800	ıp to 9600	up to 4800	Up to 50K	up to 50K	up to 50K	up to 50K	up to 2400
Code Compatible												
ASCII	✓	✓	✓	✓	✓	J	✓	✓	/	✓	✓	'
EBCDIC	✓	✓		✓	✓	/	✓	✓	J	✓	✓	'
XS-3	✓				✓			✓	✓	✓	✓	
SBT	✓	✓						✓	✓	✓	✓	
6 BIT TRANSCODE								✓	✓	✓	✓	
ıntroller Type												
(programmable, Hardwired	Programmable	Programmable	Hardwired	Hardwired	Programmable	Programmable	Hardwired	Programmable	Programmable	Programmable	Programmable	Hardwired
Memory/Buffer Size (chars)	4K	4K		400	4K	3K		4K	4K	4K	4K	
Monthly Lease, 1 year, ɔt incl. maintenance	$6 15/ $1.923	S1,160/ S890	$929	$950	$992	$1,380	$565	$1,130/ $1,245	$1 ,300/ $1.405	$1.510/ $2,035	$2,700/ $770	$900
ale Price* ıcluding card reader, ıe printer. and controlled	$18,880/ $56,190	839,880/ $35,590	$49,610	$23,000	$27,950	$34,500	$15.290	$45,200/ $49.800	$52,000/ $56,200	$60.400/ S81,400	$108,000/ S30,600	$36,000
ıecial Features/Options	Cassette 200K chars. 2400 bps opt tonal. No teleprinter on Model 515	Standalone capability. Message compression.	Mark sense card reader. Automatic retransmission.	Message compression Stand alone printer terminal available.	Compatibility for Univac OCT 2000. 1004, and IBM 2780.	Compatibility for CDC 200, Univac 1004, 6M 2780.	Unattended answering, off. line listing error detection & retransmit. CP included m price.	Expandable memory to 8K. compatible with 1004.2780 or User 200 terminals. Full transparence.	Expandable memory to 12K Compatible with 1004.278 or User 200 ter minals. Full transparence.	Expandable memory to 12K Compatible with 1004, 278(or User 200 terminals. Full transparency.	Expandable memory to 12K Compatible with 1004, 2781 or User 200 terminals. Full transparency.	Off-line ist. Unattended answer.

C-5

.-not available,

able I-b

file.

In the simple terminals with hard-wired control, data is read from the input devices in the remote-batch terminal, transmitted to the computer over a communication line, and processed at the central computer. The results are then transmitted over the communication line back to the remote-batch terminal where the output devices produce the output records. At the remote site, the control of the individual items of input /output equipment and the communication line is handled by special logic and buffers designed specifically for this purpose. For relatively simple remote-batch terminals, this hard-wired control m'ay he less expensive, but it is also significantly less flexible.

In more sophisticated remote-batch terminals, a small computer is included to store programs, to control the input/output equipment, and to do some preprocessing functions (e.g., code conversion and editing) and output functions (e.g., formatting). In such terminals the use of a minicomputer reduces the amount of data transmitted to and from the larger central computer, provides flexible control, and provides editing and formatting for the input/output equipment,

Advantages and disadvantages

The advantage of remote-batch terminals lies in permitting the distribution of people and equipment away from one central location. Inherent disadvantages of remote-batch terminals include data security, local personnel, maintenance, downtime due to communication equipment problems, and high communication cost compared to messenger service,

Other limitations in using remote-batch terminals have centered about three kinds of problems:

1. Central computer hardware and operating system software to support remote terminals has been minimal.

2. The high expense and complications associated with using data communications equipment and services forestalled a normal growth in using remote-batch terminals.

3. The proper cost-effective operating procedures and techniques were not developed primarily because of (l) and(2),

These problem areas are being addressed directly anti it seems obvious that remote-batch terminals have just begun to impact the data processing world.

Small business operations that have had either no data processing or a service bureau to support them, and larger businesses which now require more than a central computer facility, now have several alternative approaches to consider,

One obvious approach is the small stand-alone data processing system. Over 10,000 IBM System 360/20s have been sold and the new IBM System/3 is expected to sell in excess of 20,000 units in the next few years. The significant decrease in cost of small computers (typically 20% a year) has had a major impact in providing data processing capabilities for the small user, However, a large portion of the system's price is in the peripheral equipment. The central processor, with its internal storage, will represent an even smaller percentage of the total system cost in the future because the cost of logic and semiconductor memories continues to decrease,

One must consider the specific user's requirements in order to evaluate the remote-batch terminal vs. small stand-alone computers. However, there is a trend toward making terminals of these small stand-alone computers, as evidenced by the System/3. which was originally announced as only a stand-alone system but which now has communications options, A prime advantage in the terminal approach is the ability to access a large data base. However, the data base file management costs, implementation techniques, user methodology, and flexibility are significant problems in terminal systems that must be faced in the 1970 decade.

Communication networks facilitate three basic remote-batch-terminal modes of operation:

1. Point-to-point with the central computer facility.

2. Point-to-point with another remote-batch terminal.

3. Multipoint configuration to some combination of other terminals and computers.

The two parameters most commonly associated with the communications interface are the character code (e.g., ASCII or EBCDIC) and the transmission rate, In general, a remote-batch terminal can usefully support at least a 300 lpm printer and a 400 cpm card reader, provided the communications interface/controller is capable of data rates in the order of 4,800 bps or higher. The communications interface usually resides in the controller portion of the terminal where its function is to convert the bits used in the computer and terminal into the appropriate modulated, or analog, signals which can be handled over the telephone line.

Remote-batch terminals require a control unit (i.e., controller) which maintains synchronization between the transmitting and receiving equipment, controls the flow of data, provides buffer storage for input and output data, and initiates the proper control functions in the terminal itself. The controllers are either hard-wired or use a small computer to control the terminal functions. The small computer used as a controller has a well-defined control program to execute the required functions, but alternate programs maybe used for different equipment configurations and different transmission modes. These programs are normally supplied by the manufacturer.

Options and features

Many different control features and options are available for remote-batch terminals. The survey presented in Table 1 includes the optional features and equipment that can be included to meet the user's particular needs. Typical optional devices include magnetic tape units, card punches, crt displays, and other peripherals. Some of the special features available on remote-batch terminals included in this survey are:

Message compression
Error detection and retransmission
Switch-selectable character/block transmission modes
Off-line card to print
AttendecVunattended operation

Partial transmit capability
Automatic answer and turnaround
Multiline control operation
Horizontal format control on printer
Terminal ID

Certain significant trends are becoming evident which will accelerate the use and economic benefits of remote-batch terminals. Four key trends are:

1. Lower-cost peripherals will be available.
2. Communication equipment (modems and interfaces) costs will continue to decrease and units will be more readily available.
3. More central computer service facilities will be available to support user remote-batch terminals.
4. Remote-batch terminals with higher degrees of stand-alone capability will be available.

Advances in remote-batch terminals are tied almost directly to advances in input/output equipment, such as punched card readers and punches, printers, magnetic tape equipment, etc. The dominant factor in the cost (If remote-batch terminals at present is the electromechanical input/output and other peripheral equipment in the terminal. The digital logic, storage, and small computer constitute a minor portion of the total cost of the terminal.

The trend toward lower cost peripherals "is due primarily to the growing minicomputer industry where the ever-decreasing computer costs force lower-cost peripherals. Drum-type line printers typically cost $1,5.000 or more with controller. Now, lower-cost techniques (belt, matrix, and nonimpact methods) are employed to offer line printer units for less than $ 10,000 with controller. Some of the newer types of input devices include magnetic tape cartridge or cassettes where the emphasis is on lower cost, yet achieving reasonable input rates.

With the increasing availability of lower-cost modems and multiplexors from independent manufacturers, the trade-off of using a high-speed modem and/or transmission lines with a multiplexer to time-share the line becomes more attractive. A major portion of the time-share service centers now offer, or will shortly be offering, complete remote-batch terminal support with the necessary equipmeut, systems and application software that were not readily available in the past.

More alternatives

The two alternatives to remote-batch processing are the use of computers with conventional peripheral equipment for local batch processing and the use of time-sharing approaches to computation and data processing. However, the trend seems to be trrward remote-batch processing instead of local-batch processing and interactive time-sharing cannot compete on a cost basis in applications which can be handled on a batch basis. The major effect of time-sharing will be to drain away from remote-batch processing those applications in which there is an advantage in user interaction and fast response.

More and more emphasis is being placed on performing as many functions as possible in the terminal to alleviate the associated overhead in the central computer system. A major impetus for this is the effect of semiconductor technology in making cpus and memories very low cost and thus very attractive for inclusion in the terminal—i.e., terminal processors. Many of the remote-batch terminal manufacturers incorporate a minicomputer to perform control and transmission functions required in the terminal. The flexibility of a low-cost stored program minicomputer offers many advantages. It is cheaper to do some preliminary data processing tasks (e.g., sorting, data testing, data compression) in the terminal processor. Also, the terminal can be used in an off-line mode of operation for card-to-print, card-to-tape, and other operations without utilizing the communications link and central computer system.

Future design objectives

Design objectives for future systems employing remote-batch terminals should include the following:

1. Simplify and reduce the routines in the host computer required to interface with the terminal.
2. Standardize the software in the terminal processor to as great an extent as possible.
3. Minimize changes in the central or host computer software, especially operating system changes.

These trends will continue even further with terminal processors doing more of the work (e g., report generation) while access to the central computer system will be required primarily fur large data base operations and for larger programs exceeding the capabilities of the terminal processor. ■

Mr. Theis is a member of the technical staff of Aerospace Corp. He has a BS from UCLA and an MSEE from the Univ. of Southern California. He is a registered electrical engineer in the state of California.

Mr. Hobbs Is president of Hobbs Associate% Inc. He was previously with Aeroneutronic as manager of dp engineering and has also held positions with Univac and RCA. He has a BSEE from Georgia Tech, and an MSEE from the MO Ore School , Univ. of Pennsylvania, end an MBA from the Wharton School.

A survey of 52 specialized communications-handling computers from 40 vendors

Communications Processors

by D. J. Theis

Communications processors (CP's) are specialized stored-program computers that handle communications for other computers. They perform the character assembly, polling, data transmission error detection, and code conversion functions, releasing their hosts for full-time data processing. Their importance, and their numbers, are growing. Projections indicate that by 1980 over half of all computer installations will use them.

Survey criteria

We surveyed the manufacturers of CP's to produce the accompanying tables, and chose from among the questionnaire responses four overlapping classes of stored program processors that appeared to be marketed specifically for communications applications. We chose to include message-switching and store-and-forward processors (which may actually be used in stand-alone applications), remote concentrators (which may be thought of as intelligent multiplexors), IBM 270X replacements, and high-level front ends (which can replace the 2700s but also offer other capabilities). It is the nature of communications processors that a single device may be suited for several applications and therefore may belong in several of the classes. We have simply indicated on our charts for which applications each device is suited.

Several minicomputer manufacturers offer their standard model with data set interface options, but these were not included in the survey. Although the CP's all do contain computers, their special-purpose front-end hardware and especially their dedicated data communications software set them apart from general-purpose minis. We also excluded processors used primarily as the controller portion of remote batch terminals or of data entry systems, such as key-to-disc systems.

The information in the tables was supplied to us by the manufacturers prior to June 12, 1972. Although we have spent considerable time validating the data and trying to make its interpretation consistent, figures should be checked with the manufacturers directly. We have included a list of manufacturer names and addresses for this purpose. The list hits reader service card numbers for the vendors and we have notified them of the likelihood of such inquiries. Prices, of course, are subject to change without notice.

A few words about the application of these devices, especially as remote concentrators and as central-site front ends, are in order.

Remote concentrators

The cost of communications lines goes up as the distance increases, so economics can be achieved by use of a remote concentrator to accept data from low-speed lines and concentrate this traffic onto one higher speed line. In the past this concentrating function has been performed by a communications line multiplexor. The cost of a CP is higher than that of a multiplexor, but its use to multiplex communications data lines, along with the CP's inherent stored program flexibility and modular expandability, offers significant advantages. These advantages are accommodation of interfaces to special terminals; buffering capability which allows a higher concentration ratio than a hardwired multiplexor by smoothing out the peak loads; and accommodation of changes in data rates, formats, codes, communication procedures, and number of terminal devices. The programmable aspects of a CP in remote concentration applications are just beginning, and the impact of this distributed processing approach offers real promise.

Front ends

Besides the stored-program processor, the basic CP configuration has a communications line controller between the modems of the common carrier lines and the I/O channel of the computer. This controller (also called data adapter or modem controller) is not a separate piece of equipment but a few printed circuit cards mounted in a card cage in the CP enclosure. The electrical interface at the modem conforms in voltage level, plug configuration, and pin assignment of data and control signals to the EIA-STD RS-232B or MIL-STD-188B interface specifications. The controller buffers the line functions as well as the data. The information carried in line function words, in conjunction with the timing and control logic, determines the appropriate sampling rate, character size, and stop control format. There are many types of modems used requiring different controller designs unique to the particular modem characteristics.

The most common communications line control equipment is the IBM 2701, 2702, and 2703 data adapter and transmission control units. Several manufacturers offer equipment which is a plug-to-plug replacement for these hardwired units. These replacement units emulate the IBM equipment, requiring little or no change in the central computer's (IBM System/360 or 370) communications control software. Replacing the transmission control units with a CP allows the user to switch over in phased steps, where the first step is an emulator of the existing communications line control unit, which does not require changes in the host computer software.

In many computer systems, I/O controllers are external devices. Similarly, the front-end CP approach is to separate all the data communications control from the central computer. The CP controls and prepares the data from the terminals or other computer systems for use by the central computer. The front end works in parallel with the central computer to increase throughput capability of the overall system.

The execution of the individual basic communications control functions within a CP is relatively simple, but the execution concurrency of all the functions in a well-disciplined manner requires careful design. The data rates from the terminals are fixed relative to the terminal device characteristics and the modem equipment. The data transfer to the central computer is usually by high-speed block transfers. The typical front-end processor does many basic communications control functions, such as line control procedures, character-to-message assembly/disassembly, polling, message queuing, code translation, and error control and recovery.

There are different kinds of line control procedures or disciplines used—e.g., IBM's Binary Synchronous Communications (BSC)—depending on the terminal equipment. The interface between the modem equipment and the front end is activated by the control and status signals, which in turn are driven by the control routines implementing the line control procedure. The control procedure handles character synchronization of the incoming data, following which the character-to-message assembly (or disassembly) is performed. This involves a data organization to handle full message segments or blocks of data. A block of data is variable in length to allow better line utilization.

The front end can periodically poll the terminals, accepting transmission from terminals when messages are ready, and acknowledging when the message is received correctly. Polling is probably the most widely used means of network control because it permits the CP to maintain input data rate control, preventing overload conditions. Polling requires a means of addressing and maintaining status tables for each device such that the front-end processor can accommodate all the terminal-specific information. This allows the central computer to operate strictly in terms of logical, not physical, devices. The front-end processor accumulates different message segments or data blocks and queues them in memory. Queuing refers to the ordered set of messages where each queue has an entry, an exit, and a direction. The CP can also convert message segments from the transmission format to the record or file format used in the central computer.

Although ASCII and EBCDIC are the two most prevalent codes available with terminals today, there are many other 5-, 6-, 7-, or 8-bit codes in use. This is one of the main reasons CP's facilitate servicing many different kinds of terminals; CP software conversion routines provide the code commonality required by the central computer. Code conversion for input and output for several different devices can represent a significant load on a central host computer.

The degree of error detection sophistication required in message validation is highly dependent on the application. For error detection, the front end can generate vertical redundancy check (VRC) bits or longitudinal redundancy check (LRC) characters on Transmit and check them on Receive to determine bit errors or missing characters, respectively. For correction, the front-end processor can request the retransmission of the character, message, or data block containing the error. Sophisticated methods, such as error correcting codes and correction by front-end software, are available, but retransmission is used in most applications because it is the most economical approach.

Other CP features also increase communications reliability. A "fail soft" capability allows the terminals to continue to transmit even though the central computer is down for awhile. Terminal testing provides a means of diagnosing terminal trouble from the central computer site. Activity monitors can be added to display the actual measured performance levels relative to a theoretically achievable level; this provides a profile analysis of total system utilization for defined periods of time.

Many other desirable features are available on front-end CP's. For instance, line speeds can be controlled adaptively by software. Front-end sampling determines the speed and the identity of the terminal and loads the appropriate parameters into the communications control unit so data transmission can begin. These line speed sensing and addressing features can also be used in the remote concentrator.

All of this is done under the control of a front-end operating system, typically called a Network Control Program (NCP). It provides capabilities such as polling, terminal addressing, error detection, code translation, and buffering which were formerly part of the central computer's operating system. A front-end operating system must be designed to switch between many short routine tasks with a minimum overhead penalty. This feature is the key element to achieve high throughput. CP software development has reached the level of maturity where the telecommunication access method software resides in the front-end processor. Software interfaces with the central computer's operating system are required, typically a macro language with supporting I/O logic. Also, system macros are developed which can be added to the system library to allow message-processing programs within the central computer to directly access the data in the front-end processor (i.e., these macros are loading registers in the central computer). The interface software provides application programs with the means to control the queue classes between the central computer and front end. Typically, the main routines are core resident, while the less frequently used modules reside on fast access disc. The primary design goal for such a package is to isolate the application programs from the control functions.

To facilitate software development and performance, special or communications-oriented instructions are added to the repertoire of the CP. As manufacturers gain in data communications control experience, the use of new and better instructions is inevitable. One of the basic operations in communications control is queuing of data and the control information maintained as ele-

(Text continues on page 43)

ABBREVIATIONS USED IN THE TABLES

CRC	cyclic redundancy check
dma	direct memory access channel
LRC	longitudinal redundancy check
mpx	multiplexor channel
ppu	peripheral processing unit
SBT	six-bit transcode
sel	selector channel
VRC	vertical redundancy check
XS3	excess-three code

COMMUNICATIONS PROCESSORS – Summary of Characteristics

Manufacturer	American Data Systems, Inc.	Bolt, Beranek and Newman, Inc.	Burroughs Corp.	Burroughs Corp.	CDC Communications Products
Model	950	IMP/TIP - Series B	DC 1200	DC 1800	M 1000
1st installation /number inst	5/71 inst not given	9169 27 inst	6170 inst not given	6/70 10 inst	1968 20 inst
Applications					
Remote concentrator	✓	✓	✓		
270X emulator	✓			✓	
Front-end	✓	✓	✓		✓
Message switching		✓	✓		✓
Store & forward		✓	✓		✓
Computer Compatibility					
Host computers	IBM 360, 370	IBM, Univac, DEC, others	Burroughs, others	IBM 360, 370 only	CDC Cyber & 6000, IBM 360
Channels	sel, mpx, block mpx	alma, sel, mpx, block mpx	Burroughs or common carrier	mpx	sel, mpx, CDC PPU
Max word rate/path width	500 K/B bits	100K bps/1 bit	50 K/8 bits	50 KB+/8 bits	120 K/8 bits
Software compatibility	all IBM	all	Burroughs RJE, others	BTAM, QTAM, TCAM	Cyber OS, IBM OS & DOS
Special software required?	no	Network Control Prog.	no	no	yes ($ 150-300/mo)
Device emulated	IBM 2701, 2702, 2703			IBM 2701, 2703	
Internal Specifications					
Memory range/word size	8K-128K (16 bits + 2 parity)	12 K-32K (16 bits)	4K-32K (8 bits + 1 parity)	4K-32K (8 bits + 1 parity)	48 K-192K (24 bits)
Memory cycle/technology	1-usec core	900 nsec or 1.6-usec core	1.5-usec core	1.5-usec core	800- nsec core
Hardwired/microprogrammed	microprogrammed	hardwired	hardwired	hardwired	hardwired/microprogrammed
Communications instructions	translate & test	none	not given	not given	yes
Functions Performed					
Scheduling	✓	✓	✓		✓
Auto line speed sensing	✓	✓	✓		✓
Data packing/unpacking	✓	✓	✓		✓
Auto calling	✓		✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓		✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting	✓	✓	✓		✓
Transmission					
Block sizes	1-2048 bytes	10-520 words	variable	variable	80-4096 words
Buffer sizes	dynamically allocated	not applicable	variable	1-256 bytes	80-4096 words
Codes used	ASCII, EBCDIC, SBT, others	SET	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, others	ASCII, EBCDIC, Baudot
Max active asynch lines/speeds	512 lines, 75-1200 bps	63 lines, 75- 19.2K bps	65 lines, 45-1200 bps	64 lines, 45-1800 bps	512 lines, 75-1800 bps
Max active synch lines/speeds	128 lines, 1200-50,000 bps	5 lines, 9600-230.4K bps	65 lines, 2000-9600 bps	not applicable	24 lines, 2400-40.8K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware	hardware/software	hardware/software	hardware
Special checks performed	CRC, LRC, VRC, polynomial	CRC	CRC, LRC	CRC, LRC	CRC, LRC
Back-up and recovery	retransmission, redundance, software reconfigurator	retransmission	retransmission	software	fully automatic
Prices					
"Standard" configuration	32K, 128 low speed lines, 360 interface, console, power fail, mem protect	63 input ports, host interface, 2 high speed modem interfaces	16K, 16 terminal lines, host interface, *console*	16K, 32 lines, 2703 emulation software	dual exchange, protected, 64-256 lines
Purchase	$76,500	approx $120,000	$58,320	$92,000	$250,000-$600,000
Monthly maintenance	not given	not given	$147	$352	$1,000-$2,000
Monthly rental or lease	$2,065 (5 years)	not available	$1,248 (5 years)	$2,331 (5 years)	$5,000-$12,000 (1-5 years)

C-10

Summary of Characteristics . . .

Manufacturer	Chi Corp.	Collins Radio Co.	Computer Communications, Inc.	Computer Communications, Inc.	Computer Communications, Inc.
Model	Mark II	C-System	70	71	7000
1st installation/number inst	date not given 1 inst	6/67 50 inst	4/72 18 inst	date and inst not given	12/71 1 inst
Applications					
Remote concentrator		✓	✓	✓	
270X emulator					
Front-end	✓	✓	✓		✓
Message switching		✓			✓
Store & forward		✓			✓
Computer Compatibility					
Host computers	Univac 1108	IBM 360, 370; Univac	multiple IBM, CDC, Xerox	IBM, CDC, Xerox	IBM, CDC, Xerox
Channels	ESI I/O channel	sel, mpx, block mpx	mpx, block mpx	common carrier	mpx, block mpx
Max word rate/path width	100K/6-8 bits	2M/1 bit	500 K/8 bits	50 K/1 bit	500 K/8 bits
Software compatibility	EXEC 8	OS, PARS in CCP	IBM, cDC, Xerox	IBM, CDC, Xerox, others	IBM, CDC, Xerox, others
Special software required?	modified EXEC	yes (no charge)	no	no	no
Device emulated					
Internal Specifications					
Memory range/word size	4K-64K (8 bits)	16K-64K (32 bits)	8K-64K (8 bits+ 1 parity)	8K-64K (8 bits + parity)	8K (8 bits+ 1 parity)
Memory cycle/technology	1-usec core	2-usec core	1-usec core	1-usec core	1-usec core
Hardwired/microprogrammed	microprogrammed	hardwired	hardwired, microprogrammed	hardwired/microprogrammed	hardwired/microprogrammed
communications instructions		byte handling	yes	yes	yes
Functions Performed					
Scheduling		✓	✓	✓	✓
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling		✓			
Auto answering	✓	✓	✓	✓	✓
Polling		✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	variable	128-2048 bytes	1-65K bytes	1-65K bytes	1-65K bytes
Buffer sizes	variable	128-2048 bytes	any	any	any
Codes used	ASCII, EBCDIC, X53, others	ASCII	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, S8T, Baudot
Max active asynch lines/speeds	128 lines, 75-9600 bps	45-2400 bps	240 lines, to 9600 bps	240 lines, to 9600 bps	960 lines, to 9600 bps
Max active synch lines/speeds	16 lines, 20009600 bps	2000-2M bps	60 lines, 2000-50K bps	60 lines, 2000-50K bps	240 lines, 2000-50K bps
Error Checking & Recovery					
Hardware or software checks	software	hardware/software	hardware /software	hardware/software	hardware/software
Special checks performed	CRC, LRC, polynomials, etc.	CRC. LRC	CRC, LRC, polynomial	CRC, LRC, polynomial	CRC, LRC, polynomial
Back-up and recovery		software	redundance, retransmission	redundancy, retransmission	redundancy, retransmission
Prices					
"Standard" configuration	24K, 32 lines	dual processors, dual discs and tapes, card reader, line printer	16K, I/O processor, interrupt generator, 360 interface	16K, 2K ROM, interrupt generator, synchronous channel	dual processors, two discs, 16 medium or 64 low speed lines
Purchase	$60,000	$1,000,000	$47,000	$37,500	$280,000
Monthly maintenance	approx $350	$4,000	$290	$225	$1,700
Monthly rental or lease	not available	$27,000 (3 years)	$1,221 (5 years)	$961 (5 years)	$8,300 (5 years)

Summary of Characteristics . . . .

Manufacturer	Computer Control Systems, Inc.	Comtec Data Systems, Inc.	Comten, Inc.	Comten, Inc.	Comten, Inc.
Model	Teleswitcher DCS-5000	CT/90 "	20	45 and 65	3670 CCM
1st installation/number inst	1/71 10 inst	12/70 10 inst	date and inst not given	9169 inst not given	date and inst not given
Applications					
Remote concentrator	✓	✓	✓		
270X emulator		✓			✓
Front-end	✓	✓		✓	✓
Message switching	✓	✓	✓	✓	
Store & forward	✓	✓	✓	✓	
Computer Compatibility					
Host computers	IBM 360, 370	multiple IBM, Univac, others	host independent	IBM 360, 370	IBM 360, 370
Channels	sel, mpx, block mpx	alma, sel, mpx, block mpx	common carrier	sel, mpx, block mpx	mpx, block mpx
Max word rate/path width	200K/8 bits	500K/8 bits	29K8/1 bit	200 K/8 bits + parity	620K/8 bits + parity
Software compatibility	OS	BTAM, QTAM, TCAM, others	IBM 360	Comten's CTAM	all IBM
Special software required?	yes (no charge)	no	no	yes (no charge)	no
Device emulated		IBM 270X, 290X; Univac CTMC			IBM 2701, 2702, 2703
Internal Specifications					
Memory range/word size	2K-128K (16 bits)	8K-1024K (16 bits+ 2 parity)	SK-32 K (16 bits + 2 parity)	8K-128K (32 bits + 4 parity)	8K-256K (16 bits+ 2 parity)
Memory cycle/technology	2-usec core, semiconductor	800-nsec core, semiconductor	900-nsec core	1.2-usec (45)/750-nsec (65) core	650-nsec core
Hardwired/microprogrammed	hardwired/microprogrammed	microprogrammed	hardwired	hardwired	hardwired
Communications instructions	as required	read block, write block, others	allow interrupt, insert pointer, test parity, etc.	allow interrupt, insert pointer, test parity, etc.	allow interrupt, insert pointer, test parity, etc.
Functions Performed					
Scheduling	✓	✓		✓	
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	
Auto calling	✓	✓		✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing	✓	✓		✓	✓
Formatting	✓	✓	✓	✓	
Transmission					
Block sizes	1-400 bytes	1-1M words	variable	any	variable
Buffer sizes	60 bytes	8-256 words	4-64 bytes	4-128 bytes	4-64 bytes
Codes used	ASCII, EBCDIC, Baudot, others	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, others
Max active asynch lines/speeds	128 lines, to 1200 bps	1024 lines, 40-9600 bps	128 lines, 45-1800 bps	256 lines, 45-1800 bps	384 lines, 45-1800 bps
Max active synch lines/speeds	128 lines, to 19.2K bps	1024 lines, 2000-50K bps	128 lines, 2000-240K bps	160 lines, 2000-240K bps	160 lines, 2000-240K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC
Back-up and recovery	auto recovery from last message each line	multiple CPU's, auto func integrity check, network diagnostics	remote initial loading	commo line "Y" selector, redundant processors	commo line "Y" selector, redundant processors
Prices					
"Standard" configuration	not given	processor, host interface and 64 line adapters	not given	98K, 64 asynch lines, 16 synch lines, disc, card reader, printer	32K; 1 broad band, 16 tty, 16 model 2741, 4 BSC lines
Purchase	$75,000 and up	$70,000	$75,000	$239,000 (45); $285,000 (65)	$94,000
Monthly maintenance	not given	$350	not given	$1,390 (45); $1,660 (65)	$425
Monthly rental or lease	not given	$1,820 (5 years)	not available	$6,600 (45); $7,900 (65)	$1,950 (2 years)

Summary of Characteristics

Manufacturer	Cybermatics, Inc.	Data Pathing, Inc.	Digital Equipment Corp.	Digital Equipment Corp.	EMR-Computer
Model	Tin Can 1	21 00/21"04	DECcomm 11D20	DECcomm 11023	DCS-16
1st installation/number inst	date and inst not given	3/70 100 inst	12/71 30 inst	5/72 8 inst	1970 15 inst
Applications					
Remote concentrator	✓		✓		
270X emulator					✓
Front-end	✓	✓	✓	✓	✓
Message switching	✓		✓		✓
Store & forward	✓		✓		✓
Computer Compatibility					
Host computers	IBM 360, Univac 1108, 418	IBM, Univac, Burroughs, GE	DECsystem 10, IBM 360	IBM 360, 370	IBM, Univac, Burroughs
Channels	sel, mpx, block mpx	sel, mpx, block mpx	alma, sel, mpx, block mpx	set, mpx, block mpx	alma, sel, mpx
Max word rate/path width	not given	125K/8 bits	250 K/8 bits	250K/8 bits	2M/16 bits
Software compatibility	not given	IMS, BTAM	GAM, TCAM, QTAM	GAM, TCAM, QTAM, BTAM	BSAM, BTAM, QTAM
Special software required?	no	no	no	no	no
Device emulated		mag tape controller or crt	IBM 2780, 2848	IBM 2848	IBM 270X or peripheral
Internal Specifications					
Memory range/word size	12 K-128K (16 bits + 1 parity")	16K-32K (S bits + 1 parity)	4K-128K (16 bits+ 1 parity*)	4K-128K (16 bits + 1 parity*)	8K-32K (16 bits + 1 parity)
Memory cycle/technology	900-nsec or 1.2-usec core	1-usec core	900-nsec core	900. nsec core	500-nsec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired	hardwired	hardwired
Communications instructions	none	yes	byte handling	byte handling	not given
Functions Performed					
Scheduling	✓	✓	✓	✓	✓
Auto line speed sensing			✓	✓	
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓		✓	✓	✓
Auto answering	✓		✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	
Routing	✓	✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	1-32K bytes	to 250 bytes	variable	variable	50-500 words
Buffer sizes	variable	to 960 bytes	variable	variable	50-500 words
Codes used	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, others	ASCII, EBCDIC, SBT	ASCII, EBCDIC, SBT	any
Max active asynch lines/speeds	64 lines, 502400 bps		100 lines, to 9600 bps	100 lines, to 9600 bps	250 lines, 75-1200 bps
Max active synch lines/speeds	64 lines, 2400-40.8K bps	10 lines, 1200-50K bps	10 lines, to 50K bps	10 lines, to 50K bps	60 lines, 1200-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, parity	CRC, LRC, modulus	CRC, LRC	CRC, LRC	CRC, LRC, character parity
Back-up and recovery	software and storage	dual processor, dual *tape, auto* repelling	auto retransmission	auto retransmission	fail soft hardware
Prices					
"Standard" configuration	not given	32K, Teletype, 16K drum, mag tape, 4 lines	PDP 11/20, ASR 33 Teletype, clock	16K PDP-11/20, ASR 33 Teletype, 360 interface, clock	CPU, disc, peripherals, commo control unit, line interfaces
Purchase	$50,000	$60,000	$16,400	$30,900	$180.000
Monthly maintenance	not given	$500	nor given	$188	not given
Monthly rental or lease	not given	$1,200 (5 years)	not available	not available	$4,200 (5 years)
	" Optional		" Optional	• Optional "	

Summary of Characteristics . . .

Manufacturer	EM R-Computer	General Electric Co.	General Instrument Corp.	Honeywell, Inc.	Honeywell. Inc.
Model	DCS-45	DigiNet 1600	System 75	Datanet 355	Datanet 2000
1st installation/number inst	1971 1 inst	3/71 inst *not* given	10/71 10 inst	11170 inst not given	12/72 inst not applicable
Applications					
Remote concentrator		✓	✓		
270X emulator	✓	✓			
Front-end	✓		✓	✓	✓
Message switching	✓	✓	✓	✓	
Store & forward	✓	✓	✓		
Computer Compatibility					
Host computers	EM, Univac, Burroughs	IBM 360, HIS 6000, others	IBM 360, 370	HIS 600, 6000	HIS 200, 2000
Channels	alma. sel, mpx	alma, mpx	sel, mpx	dma	mpx, block mpx
Max word rate/path width	6M/ 16 bits	225K/16 bits	800K/16 bits	500K/6-36 bits	42 K/% bits
Software compatibility	not given	TCP OS	OS MVT	GcOS	0s/2000
Special software required?	no	no	no	no	no
Device emulated	IBM 270X 'or peripheral	IBM 270X	IBM *2803, 3803*		
Internal Specifications					
Memory range/word size	32 K-128K (16 bits +	4K-32K (16 bits)	2K-32 K (16 bits)	16 K-32K (1'6 bits+ 2 parity)	16 K-32K (16 bits+ 1 parity)
Memory cycle/technology	600-nsec core	1.2-usec core	800-nsec or 1.2-usec core, semi	1-usec core	780-nsec core
Hardwired/micro programmed	hardwired	hardwired	hardwired/microprogrammed	hardwired	hardwired
Communications instructions	not given	SCAN (services low speeds)	yes	yes	stack addressing
Functions Performed					
Scheduling	✓		✓	✓	
Auto line speed sensing		✓		✓	
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓	✓	✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition		✓	✓	✓	✓
Routing	✓	✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	50-500 words	variable	1-32K words	any	any
Buffer sizes	50-500 words	not applicable	16-512 words	variable	dynamically allocated
Codes used	all codes	ASCII	ASCII, EBCDIC, special	ASCII, EBCDIC	ASCII, EBCDIC, ISO, Baudot
Max active asynch lines/speeds	500 lines, 75-1200 bps	128 lines, 110-4500 bps	128 lines, 110-1800 bps	200 lines, 75-9600 bps	120 lines, 45-2400 bps
Max active synch lines/speeds	120 lines, 1200-50K bps	32 lines, 300-50K bps	128 lines, 2400-50K bps	32 lines, 75-50K bps	120 lines, to 10,SK bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware /software	hardware/software	hardware /software
Special checks performed	CRC, LRC, character parity	CRC,LRC	CRC, LRC	LRC. parity	CRC, LRC, parity
Back-up and recovery	fail soft hardware	bootstrap loader	retransmit, tine-out, retry	retransmission, reload	mass storage, program reload
Prices					
"Standard" configuration	CPU, disc, peripherals, commo control unit, line interfaces	SK, 30 channels	*SK*, ASR 33 Teletype, disc, crt, tape, 50K baud DCA	16K, 32 *tines*	40K, console, 20 synch and 20 asynch fines
Purchase	$250,000	$32,000	$45,000	$152,000	$87,920
Monthly maintenance	not given	$200	$300	$476	$346
Monthly rental or lease	$6,400 (5 years)	$1,100 (3 years)	$900 (5 years)	$2,941 (5 years)	$2,0?6 (5 years)

Summary of Characteristics. . .

Manufacturer	North American Philips Corp.	Omnus Computer Corp.	Prentice Electronics Corp.	Pro ramming Metlsods, Inc.	Remote Computing Corp.
Model	DS 714	1/C	P-3000	FCF	FRED
1st installation/number inst	1965 45 inst	8/7 1 1 inst	1 2/72 inst nOt applicable	6/7 1 5 inst	date not given 6 inst
Applications					
Remote concentrator		✓		✓	✓
270X emulator					
Front-end		✓	✓	✓	✓
Message switching	✓	✓		✓	✓
Store & forward	✓	✓		✓	
Computer Compatibility					
Host computers	not applicable	1 BM 360, others	IBM 360, 370	IBM, CDC, GE	IBM, Burroughs, Univac
	not applicable	not given	set, mpx, block mpx	sel, mpx, block mpx	not given
Max word rata/path width	not applicable	833 K/8-16 bits	not given	1.4 M/8 bits	not given
Software compatibility	not applicable	not given	GAM, BTAM, QTAM, TCAM	CICS, Intercomm, BCCAP	not given
Special software required?	not applicable	not given	no	no	yes (approx $40K)
Device emulated	not applicable		IBM 270X, 3705	tape drive	--
Internal Specifications					
Memory range/word size	16K-256K (32 bits + 4 parity)	4K-32K (16 bits)	16 K-240K (8 bits)	8K-64K (16 bits)	24 K-64K (16 bits+ 1 parity)
Memory cycle/technology	2.2-usec core, semiconductor	1 .2-usec core	1-usec core, 200-nsec semi	700-nsec core	1-usec core.
Hardwired/microprogrammed	hard wired	hardwired	microprogrammed	hardwired	hardwired/microprogrammed
Communications instructions	not given	byte, stack manip., etc.	yes	yes	yes
Functions Performed					
Scheduling	J	✓	J	✓	
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	J
Auto calling	✓	✓	J	✓	✓
Auto answering	✓	✓	J	✓	✓
Polling	✓	✓	J	✓	
Terminal recognition		✓	J	✓	✓
Routing	✓	✓	J	✓	
Formatting	✓	✓	J	✓	
Transmission					
Block sizes	1-16K bytes	variable	variable	1-1024 words	
Buffer sizes	dynamically allocated	variable	variable	32-256 words	
Codes used	ASCII, EBCDIC, SET, others	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SST	ASCII, EBCDIC, SBT	AsCII. EBCDIC, Corres.
Max active asynch lines/speeds	8000 lines, 45-4800 bps	224 lines, to 9600 bps	352 lines, to 9600 bps	256 lines, 25-4800 bps	256 lines, 75-1800 bps
Max active synch lines/speeds	240 lines, 2009600 bps	224 lines, to 9600 bps	60 lines, 2400-50K bps	256 lines, 300-50K bps	256 lines, 2000-9600 bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware /software	hardware	hardware/software
Special checks performed	CRC. LRC, SEQ, format, etc.	CRC, LRC	CRC, LRC	CRC, LRC	CRC
Back-up and recovery	dual processors, configuration switching	auto restart, remote bootstrap	device switching	fully duplex, auto restart & recovery	retry
Prices					
"Standard" configuration	fully redundant, dual CPU, 2 drums, 5 tapes, 125 lines	16 asynch lines	16K, dual processor, 4K control memory, 40 asynch lines	mix of line speeds with code conversion, drum	48 lines and interface to dual processor B5500/B5700
Purchase	$1,900,000	$10,740	$49,250	$700,000	$100,000
Monthly maintenance	not given	$130	$300	not given	$1,000 (software)
Monthly rental or lease	not given	$225 (5 years)	$1,530 (2 years)	$18,900 (5 years)	$4,000 (3 years)

Summary of Characteristics . . .

Manufacturer	Sanders Data Systems, Inc.	Scantlin Electronics, Inc.	Scidata, Inc.	Scientific Control Corp.	Telefile Computer Products
Model	Sandac 200	801	" "	5000	T-64-1
1st installation/number inst	1/69 inst not given	9/71 inst not given	7/72 1 inst	1969 18 inst	7/71 9 inst
Applications					
Remote concentrator	✓	✓		✓	✓
270X emulator					✓
Front-end	✓	✓	✓	✓	✓
Message switching	✓	✓	✓	✓	✓
Store & forward	✓	✓	✓	✓	✓
Computer Compatibility					
Host computers	IBM 360, 370, others	IBM 360, Varian 620, CDC 160G	IBM 360	IBM, Univac, Burroughs	IBM 360, 370
Channels	sel, mpx," block mpx	not given	sel, mpx	alma. sel	alma, sel, mpx
Max word rate/path width	625K/8 bits	9600 bps/1 bit	not given/8-16 bits	500 K/8 bits	30K/16 bits
Software compatibility	BTAM, QTAM	BTAM, QTAM, TCAM	OS	OS, DOS, EXEC 8	BT AM
Special software required?	no	no	no	yes (no charge)	no
Device emulated	. .	IBM 2848, 2740		IBM 27XX	IBM 2701, 2702, 2703
Internal Specifications					
Memory range/word size	8K-64K (16 bits+ 2 parity)	8K-64K (16 bits + 2 parity)	8K-128K (16 bits)	4K-64K (16 bits + 1 parity)	4K-64K (16 bits + 2 parity)
Memory cycle/technology	2-usec core	750-nsec core	1.2-usec core	980-nsec core	1-usec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired	microprogrammed	hardwired
Communications instructions	not given	bit and byte handling, etc.		not given	external status, command-out, etc
Functions Performed					
Scheduling		✓	✓	✓	
Auto line speed sensing					✓
Data packing/unpacking		✓	✓	✓	✓
Auto calling		✓	✓	✓	✓
Auto answering		✓		✓	✓
Polling		✓	✓	✓	✓
Terminal recognition			✓	✓	✓
Routing		✓	✓	✓	✓
Formatting		✓	✓	✓	✓
Transmission					
Block sizes	to 1024 words	1-64K words	any	1-4K words	to 4K words
Buffer sizes	not given	1-128 words	1-256 words	1-4K words	to 4K words
Codes used	ASCII, EBCDIC	all 5-8 level codes	ASCII, EBCDIC	ASCII, EBCDIC, SBT	ASCII, EBCDIC
Max active asynch lines/speeds	45-1800 bps	384 lines, 37.5-2400 bps	38 lines, 50-1800 bps	1024 lines, to 1800 bps	64 lines, 45-1800 bps
Max active synch lines/speeds	2000-9600 bps	192 lines, 2400-9600 bps	6 lines, to 9600 bps	32 lines, 2400-50K bps	64 lines, 2000-9600 bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC	CRC, LRC	CRC	CRC, LRC	CRC, LRC
Back-up and recovery	--	redundancy, hard/soft restarts	time-variable, check-point/restart	multiple cpu's, retransmission	dual system
Prices					
"Standard" configuration	not given	16K, 64 line interface, 4 synch lines, disc, console	6 lines, printer, mag tape, disc, console, crt, back-up tty	8K, ASR 33 Teletype, interfaces, disc	4 synch lines, 12 asynch lines
Purchase	$60,000	$68,000	$93,600	$40,000	$44,950
Monthly maintenance	not given	$350	$485	$400	$188,79
Monthly rental or lease	not given	$1,500 (5 years)	not available	$1,000 (5 years)	$998.89 (5 years)

Summary of Characteristics . . .

Manufacturer	Teleprocessing Industries, Inc.	Tempo Computers, Inc.	Tempo Computers, Inc.	Texas Instruments, Inc.	Univac
Model	C2000	I and II	270T	980 DCS	C/S?
1st installation/number inst	7/71 12 inst	12/69 62 inst	8/71 12 inst	6/70 12 inst	date not given 4 inst
Applications					
Remote concentrator		✓		✓	✓
270X emulator			✓		
Front-end	✓	✓	✓		✓
Message switching		✓		✓	
Store & forward		✓		✓	
Computer Compatibility					
Host computers	Univac 1108, 1106, 418	IBM, HIS, CDC, Xerox	IBM 360, 370	IBM 360, 370	Univac 1100
Channels	mpx	sel, mpx, block mpx	sel, mpx	sel, mpx	sel
Max word rate/ path width	50K/18 bits	1.4 MB/8 bits	not given	125K/1 bit	300K/36 bits
Software compatibility	SO EXEC 8		BTAM, QTAM, TCAM, HASP	all IBM for 270X	EXEC 8
Special software required?	yes	not given	no	no	no
Device emulated	--	--	IBM 2703	IBM 2848	--
Internal Specifications					
Memory range/word size	8K (18 bits)	8K-128K (8 bits)	8K-128K (8 bits+ 1 parity)	4K-64K (16 bits +1 parity)	16 K-64K (16 bits+ 1 parity)
Memory cycle/technology	900-nsec core, semiconductor	900-nsec core	750-nsec core	750-nsec semiconductor	630-nsec plated wire
Hardwired/microprogrammed	hardwired	hardwired	hardwired	hardwired/microprogrammed	
Communications instructions	not given	not given	not given	25, esp. for mult. interfaces	52 instructions
Functions Performed					
Scheduling		✓	✓	✓	✓
Auto line speed sensing		✓	✓		
Data packing/unpacking		✓	✓	✓	✓
Auto calling		✓	✓	✓	✓
Auto answering		✓	✓	✓	✓
Polling		✓	✓	✓	✓
Terminal recognition		✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting		✓	✓	✓	✓
Transmission					
Block sizes	not applicable	variable	any	any	variable
Buffer sizes	3-8 words	variable	any	any	variable
Codes used	ASCII, Baudot	any	any	ASCI 1, EBCDIC, Baudot	ASCII, EBCDIC, XS3, Baudot
Max active asynch lines/speeds	208 lines, to 1800 bps	768 lines, 2%4800 bps	255 lines, 25-4800 bps	256 lines, 45-1800 bps	128 lines, 45-1800 bps
Max active synch lines/speeds	48 lines, to 9600 bps	256 lines, to 50K bps	255 lines, to 230.4K bps	256 lines, 1200-IM bps	128 lines, 2000-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware	hardware/software	hardware/software	software	software
Special checks performed	LRC, VRC	CRC, LRC	CRC, LRC	CRC, LRC, parity, blk sum	CRC, LRC, character parity
Back-up and recovery	--	--	retransmission	auto restart, mag tape back-up	error logging, loop - back testing
Prices					
"Standard" configuration	32 TWX/ Data-Phone lines., 32 synch lines. 132 asynch lines	not given	not given	6 commo lines, 2MB storage	49KB, 16 asynch lines, 8 synch lines, intelligent channel
Purchase	$140,000	$50,000-$250,000	$50,000-$250,000	$50,000	$125,640
Monthly maintenance	not given	$250-$1,250	$250-$1,250	$300	$505
Monthly rental or lease	not applicable	$1,000-$5,000 (5 years)	$1,000-$5,000 (5 years)	$1,100 (5 years)	$1,966 (5 years)

Communications Processors

ments in a linked list. Stack control instructions are useful in this kind of operation. High-speed I/O read/write commands are necessary to CP applications; load and store bytes from buffered blocks is another useful type of instruction. Instructions are also used to handle code translation, such as indexing tables, and to look for special

(Text continues on page 44)

Further information on products covered in this survey can be obtained from the vendors by circling the appropriate numbers on the reader service card:

AMERICAN DATA SYSTEMS, INC.
8851 Mason Ave.
Canoga Park, CA 91306
CIRCLE 160 ON READER CARD

BOLT, BERANEK AND NEWMAN, INC.
50 Moulton St.
Cambridge, MA 02138
CIRCLE 161 ON READER CARD

BURROUGHS CORP.
Burroughs Place
Detroit, MI 48232
CIRCLE 162 ON READER CARD

CONTROL DATA CORP.
Communication Products Div.
(MDM Communications Div.)
3519 W. Warner Ave.
Santa Ana, CA 92704
CIRCLE 163 ON READER CARD

CHI CORP.
11000 Cedar Ave.
Cleveland, OH 44106
CIRCLE 164 ON READER CARD

COLLINS RADIO CO.
1200 North Alma Road
Richardson, TX 75(1X()
CIRCLE 165 ON READER CARD

COMPUTER COMMUNICATIONS, INC.
5933 W. Slauson Ave.
Culver City, CA 90230
CIRCLE 166 ON READER CARD

COMPUTER CON 11(]1, SYSTEMS, INC.
13740 Gamma Road
Dallas, TX 75240
CIRCLE 167 ON READER CARD

COMPUTER DATASYSTEMS, INC.
12701 S. Van Ness Ave.
Hawthorne, CA 90250
CIRCLE 168 ON READER CARD

COMTEN, INC.
1950 W. County Road B-2
St. Paul, MN 55113
CIRCLE 169 ON READER CARD

CYBERMATICS, INC.
560 Sylvan Ave.
Englewood, NJ 07632
CIRCLE 170 ON READER CARD

DATAPATHING, INC.
370 San Aleso Ave.
Sunnyvale, CA 94086
CIRCLE 171 ON READER CARD

DIGITAL EQUIPMENT CORP.
146 Main St.
Maynard, MA 017. 54
CIRCLE 172 ON READER CARD

FABRI-COMPUTER
8001 Bloomington Fwy.
Minneapolis, MN 55420
CIRCLE 173 ON READER CARD

GENERAL ELECTRIC CO.
Data Communication Products Div.
1 Mountain View Road
Lynchburg, VA 24501
CIRCLE 174 ON READER CARD

GENERAL INSTRUMENT CORP.
Electronic Systems Div.
1 (lo Andrews Road
Hicksville, NY 11802
CIRCLE 175 ON READER CARD

HONEYWELL, INC.
200 Smith St.
Waltham, MA 02154
CIRCLE 176 ON READER CARD

INFORMATICS, INC.
Communication Systems Div.
65 Route 4
River Edge, NJ 07661
CIRCLE 177 ON READER CARD

INTERCOMPUTER COMMUNICATIONS CORP.
2201 E. University Drive
Phoenix, AZ 85034
CIRCLE 178 ON READER CARD

INTERDATA, INC.
2 Crescent Place
Oceanport, NJ 07757
CIRCLE 179 ON READER CARD

IBM CORP.
1133 Westchester Ave.
White Plains, NY 1(16[)4
CIRCLE 180 ON READER CARD

Summary of Characteristics . . .

Manufacturer	UCC Communication Systems	Varian Data Machines
Model	COPE 1201-00	620-DC
1st installation/number inst	2/68 over 50 inst	1/71 30 inst
Applications		
Remote concentrator		✓
270X emulator		
Front-end	✓	✓
Message switching		✓
Store & forward		✓
Computer Compatibility		
Host computers	multiple IBM, CDC, Univac	IBM 360
Channels	sel mpx	sel, mpx
Max word rate/path width	200K/6-8 bits	200K/8 bits
Software compatibility	IBM, CDC, Univac	not given
Special software required?	yes (no charge)	yes
Device emulated		IBM 2803
Internal Specifications		
Memory range/word size	12K-64K (12 bits + 1 parity)	4K-32K (16 bits + 1 parity)
Memory cycle/technology	1.6-usec core	750 or 950-nsec core
Hardwired/microprogrammed	hardwired	hardwired
Communications instructions	yes	not given
Functions Performed		
Scheduling		✓
Auto line speed sensing		✓
Data packing/unpacking	✓	✓
Auto calling		✓
Auto answering	✓	✓
Polling		✓
Terminal recognition	✓	✓
Routing	✓	✓
Formatting	✓	✓
Transmission		
Block sizes	7-1024 words	variable
Buffer sizes	16-1024 words	variable
Codes used	ASCII, EBCDIC, XS3, others	ASCII, EBCDIC
Max active asynch lines/speeds	not applicable	64 lines, to 1200 bps
Max active synch lines/speeds	30 lines, 2000-50K bps	64 lines, to 50K bps
Error Checking & Recovery		
Hardware or software checks	hardware/software	hardware/software
Special checks performed	block seq. no., protocol seq.	CRC, LRC, parity
Back-up and recovery	mass storage	dual redundant systems
Prices		
"Standard" configuration	20K, console, 4 synch interfaces, card reader	8K, 64 channels, 16 lines, ASR 33 Teletype
Purchase	$118,400	$23,500
Monthly maintenance	$420	$300
Monthly rental or lease	$2,775 (5 years)	$750 (3 years)

page 43

JACQUARD SYSTEMS
1505 11th St.
Santa Monica, CA 90404
CIRCLE 181 ON READER CARD

MICRODATA CORP.
644 E. Young St.
Santa Ana, CA 92705
CIRCLE 182 ON READER CARD

MODULAR COMPUTER SYSTEMS
1650 W. MacNab Road
Fort Lauderdale, FL 33309
CIRCLE 183 ON READER CARD

NORTH AMERICAN PHILIPS CORP.
91 McKee Drive
Mahwah, NJ 07430
CIRCLE 184 ON READER CARD

OMNUS COMPUTER CORP.
1538 E. Chestnut St.
Santa Ana, CA 92701
CIRCLE 185 ON READER CARD

PRENTICE ELECTRONICS CORP.
795 San Antonio Road
Palo Alto, CA 94303
CIRCLE 186 ON READER CARD

PROGRAMMING METHODS, INC.
1301 6th Ave.
New York, NY 10019
CIRCLE 187 ON READER CARD

REMOTE COMPUTING CORP.
One Wilshire Bldg., Suite 1400
Los Angeles, CA 90017
CIRCLE 188 ON READER CARD

SANDERS DATA SYSTEMS, INC.
Daniel Webster Hwy. So.
Nashua, NH 03060
CIRCLE 189 ON READER CARD

SCANTLIN ELECTRONICS, INC.
5454 Beethoven St.
Los Angeles, CA 90066
CIRCLE 190 ON READER CARD

SCIDATA, INC.
3 Executive Park Drive NE
Atlanta, GA 30329
CIRCLE 191 ON READER CARD

SCIENTIFIC CONTROL CORP.
2519 National Drive
Garland, TX 75041
CIRCLE 192 ON READER CARD

TELEFILE COMPUTER PRODUCTS
17785 Sky Park Circle
Irvine, CA 92664
CIRCLE 193 ON READER CARD

TELEPROCESSING INDUSTRIES, INC.
82 McKee Drive
Mahwah, NJ 07430
CIRCLE 194 ON READER CARD

TEMPO COMPUTERS, INC.
(GTE Information Systems)
4005 Artesia Ave.
Fullerton, CA 92633
CIRCLE 195 ON READER CARD

TEXAS INSTRUMENTS, INC.
P.O. Box 1444
Houston, TX 77001
CIRCLE 196 ON READER CARD

UNIVAC DIV.
Sperry Rand Corp.
P.O. Box 500
Blue Bell, PA 19422
CIRCLE 197 ON READER CARD

UCC COMMUNICATION SYSTEMS
1400 UCC Tower
P.O. Box 6228
Dallas, TX 75222
CIRCLE 198 ON READER CARD

VARIAN DATA MACHINES
2722 Michelson Drive
Irvine, CA 92664
CIRCLE 199 ON READER CARD

characters. Special instructions to generate cyclic redundancy checksum (CRC) are also utilized.

A high-level front-end CP not only provides the basic communications control functions but one or more significant additional capabilities, such as communications file management, load sharing, self-contained message switching, and others. These capabilities often require peripheral devices (e.g., disc) on the front end, as in the case of the load-sharing example, a dual front-end processor configuration. High-level front-end systems are typically tailored to specific application requirements. These systems cost much more because of the customized software development and, often, the end of special hardware interface boxes.

Both current and future data communications problems have solutions which necessitate further development of the front-end CP approach. Front-end systems are going to continue to evolve in many significant ways:

1. As the trend of new terminals and the demand for additional lines continue, front-end systems must be able to accommodate these changes easily (e.g., read in the data entries for the new terminal and/or line, and the system is operational in the new configuration).

2. As much of the application preprocessing as can be partitioned will be performed remotely (e.g., this remote preprocessing capability is presently seen in "smart," or "intelligent," terminals).

3. The front-end CP will be designed to be independent of the central host computer in the "fail soft" sense.

The overall trend is definitely towards distributed processing configurations to achieve higher efficiencies and usefulness. □

Mr. Theis is a member of the technical staff of Aerospace Corp. He has a BS from UCLA and an MSEE from the Univ. of Southern California. He is a registered electrical engineer in the state of California.

APPENDIX H

GEOLOGICAL SURVEY OCS DATABASE

1.0 CONSERVATION DIVISION DATA FILES

Several files of data gathered by the Geological Survey's Conservation Division in their OCS supervisory role would be a valuable asset to BLM in support of their OCS environmental assessment studies. These files contain data on lease production, accidents connected with oil and gas operations, and platform inspections.

Of the three sets of data, only the accident reporting system has yet to be automated. Development of that system is scheduled to begin in approximately one month (May, 1975). Manually prepared, semi-annual reports are currently distributed, A synopsis of the lastest report is provided in Exhibit 1-1.

The Lease Production System currently in use was developed by GS Gulf Coast Region, Oil and Gas Branch Operations staff. The system was programmed in Fortran using sequential files with fixed format records containing character strings between 80 and 685 characters per record. Contained within the data (as shown in Exhibit 1- 2) are monthly summaries of oil, gas and condensate production with gas sales, fuel, flare and injection subtotals by lease, lease block, field and operator. All of the information in this form is public domain under OCS Operating Order No. 12 of August 13, 1971.

The Platform Inspection System was written by GSA staff under the supervision of the Gulf Coast Region Conservation Division in Cobol using fixed format sequential files. Two files of textual data are maintained: a platform inspection status record which is updated after each inspection, and an enforcement action history file containing a historical record of Incidents of Non- Compliance (INC) and Potential Incidents of Non-Compliance (PINC) associated with particular platforms. Each month, or more often if necessary, the files are merged and printed for use by the platform inspection team. The system is currently being modified to reduce its

EXHIBIT 1-1. (Sheet 1 of 7)

ACCIDENTS CONNECTED WITH FEDERAL OIL AND GAS OPERATIONSIN THE OUTER CONTINENTAL SHELF

GULF OF MEXICO

Below are guidelines used in classifying the different accidents connected with Federal Oil and Gas Operations in the Outer Continental Shelf:

Table A: Blowouts - refers to an uncontrollable flow of fluids from a wellhead or wellbore. A flow of fluids from a flowline is not considered a blowout as long as the wellhead control valves can be automatically or manually activated. If the wellhead control valves become inoperative the flow is classified as a blowout. When fire and/or significant pollution results from the blowout, the incident is also recorded in the other respective categories.

Table B. Explosions and Fires - refers to all explosions and fires directly related to drilling, producing, storing, or transporting oil and gas on or from OCS leases. All explosions and fires are recorded. When pollution of 50 or more barrels of oil results from the explosion or fire the incident also recorded as a Significant Pollution Incident.

Table C. Pipeline Breaks or Leaks - all reported pipeline breaks or leaks resulting in 50 or more barrels of oil spillage are recorded. They are also recorded as Significant Pollution Incidents.

Table D. Significant Pollution Incidents - spills are classified by the National Contingency Plan into three categories:

a. Minor - less than 10,000 gal. (238 bbls.)
b. Medium - 10,000 to 100,000 gal.
c. Major - over 100,000 gal.

However, all spills in the amount of 50 bbls. (2,100 gal.) or more are recorded.

Table E. Major Accidents includes spills of over 10,000 gallons (233 bbls.) and includes blowouts, explosions and fires creating major structural damage or blow-outs, explosions and fires resulting in loss of life.

Footnotes
A/ See also, Blowouts
B/ See also, Explosions and Fires
C/ See also, Pipeline Breaks and Leaks
D/ See also, Significant Pollution Incidents
E/ See also, Major Accidents

EXHIBIT 1-1 (Sheet 2 of 7)

MAJOR OIL SPILL INCIDENTS - OCS

Calendar Year	Incidents	Oil Spilled	Number of Fixed Structures	Annual OCS Production
1964	5	14,928 barrels	1,100	122 million barrels
1965	2	2,188 barrels	1,200	145 million barrels
1966	0	None	1,325	189 million barrels
1967	1	160,[illegible]39 barrels	1,450	222 million barrels
1968	1	6,000 barrels	1.575	269 million barrels
1969	6	30,024 barrels	1,675	313 million barrels
1970	3	83,895 barrels	1,800	361 million barrels
1971	1	450 barrels	1.891	419 million barrels
1972	0	None	1,935	407 million barrels
1973*	4	22,175 barrels	2,001	342 million barrels
1974*	2	22,046 barrels	2,054	322 million barrels
	25	322,345 barrels		3,115 million barrels

* Gulf of Mexico Area only.

EXHIBIT 1-1 (Sheet 3 of 7)

ACCIDENTS CONNECTED WITH FEDERAL OIL ANT) GAS
OPERATIONS IN THE OUTER CONTINENTAL SHELF
GULF OF MEXICO

Blowouts (TABLE A)

	Area and Block Lease & Well No. Operator	Date and Duration	Type Accident, Related Depth	How Controlled	Volume Oil Spilled (bbls.)	Injuries, fatalities, damage to property or environment
1,	Vermilion Blk. 26 OCS 029, Well A-1 Union Oil Co. of Calif.	6-8-56 to 11-20-56	Blowout, Gas; 11,435' Fire. B/E/	Drilled relief well,	None	Lost platform, rig, and two wells.
2.	Eugene Island Blk. 175 OCS 0438, well A-6 Sinclair Oil & Gas Co.	10-19-57 (11 hrs.)	Blowout, Gas; 11,290' Fire. B/	Bridged	None	Minor damage to rig.
3.	South Pass Blk. 27 OCS 0353, Well 25 Shell Oil Co.	6-14-58 (2 hrs.)	Blowout, Gas; 1,869' Fire. B/	Bridged	None	Minor damage to rig.
4.	So, Timbalier Blk. 134 OCS 0461, Well D-1 Gulf 0.(.1 Corp.	7-26-59 (f' hrs.)	Blowout, Gas; ,4,880' Fire. B/E/	Bridged	None	One killed, seven injured, rig damaged.

B/ See also, Explosions and Fires Table B
D/ See also} Significant Pollution Incidents, Table D
E/ See also, Major Accidents 'i'able E

EXHIBIT 1-1 (Sheet 4 of 7)

TABLE B

ACCIDENTS CONNECTED WITH FEDERAL OIL AND GAS OPERATIONS IN THE OUTER CONTINENTAL SHELF GULF OF MEXICO

Explosions and Fires

	Area and Block Lease & Well No. Operator	Date and Duration	Type Accident, Related Depth	How Controlled	Volume Oil Spilled (bbls.)	Injuries, fatalities, damage to property or environment
1.	Vermilion Blk. 26 OCS 029, Well No. A-1 Union Oil Co.	6-8-56 to 11-20-56	Blowout, Gas; 11,435' Fire. A/E/	Drilled relief well.	None	Lost platform, rig and two wells.
2.	Eugene Island Blk. 175 OCS 0438, Well No. A-6 Sinclair Oil & Gas Co.	10-19-57 (11 hrs.)	Blowout, Gas; 11,290' Fire. A/	Bridged	None	Fire damaged derrick (replaced).
3.	South Pass Blk. 27 OCS 0353, Well No. 25 Shell Oil Company	6-14-58 (2 hrs.)	Blowout, Gas; 1,869' Fire. A/	Bridged	None	Fire caused minimal damage.

A/ See also, Blowout, Table A
D/ See also, Significant Pollution Incidents, Table D
E/ See also, Major Accidents, Table E

EXHIBIT 1-1 (Sheet 5 of 7)

TABLE C

ACCIDENTS CONNECTED WITH FEDERAL OIL AND GAS OPERATIONS IN THE OUTER CONTINENTAL SHELF GULF OF MEXICO

Pipeline Breaks or Links

	Area and Block Lease & Well No. Operator	Date and Duration	Type Accident, Related Depth	How Controlled	Volume Oil Spilled (bbls.)	Injuries, fatalities, damage to property or environment
1.	Main Pass Blk. 42 OCS-G 1367 Chevron Oil Co.	2-7-67	Pipeline leak. Cause unknown. D/	Line shut-in and repaired.	65	No recorded environmental damage.
2.	West Delta Blk. 73 OCS-G 1083 Humble Pipeline Co.	10-15-67 to 10-27-67	Pipeline leak caused by anchor dragging. D/E/	Line shut-in and repaired.	160,639	No recorded environmental damage.
3*	So. Timbalier Blk. 131 OCS 0457 Gulf Oil Co.	3-12-68	Pipeline break caused by anchor dragging. D/E/	Line shut-in and repaired.	6,000	No recorded environmental damage.
4.	So. Timbalier Blk. 44 Pipeline from S.T. 131, 135 & 176 flds. to B.M. Sta. Gulf Oil Co*	1-24-69 to 1-30-69	Pipeline leak probably caused by pigging. D/	Line repaired	Est. over 100	No recorded environmental damage.

D/ See also, Significant Pollution Incidents, Table D

E/ See also, Major Accidents, Table E

EXHIBIT 1-1 (Sheet 6 of 7)

TABLE D

ACCIDENTS CONNECTED WITH FEDERAL OIL AND GAS OPERATIONS IN THE OUTER CONTINENTAL SHELF GULF OF MEXICO

Significant Pollution Incidents*
*50 bbl. (2,100 gal.) or more

	Area and Block Lease & Well No. Operator	Date and Duration	Type Accident, Related Depth	How Controlled	Volume Oil Spilled (bbls.)	Injuries, fatalities, damage to property or environment
1.	West Delta Blk. 117 OCS-G 1101, Well A-5 Gulf Oil Corp.	1-20-64 to 1-27-64	Gas & oil blow-out; fire. A/B/E/	Bridged	500	Platform damaged extensively. No recorded environmental damage.
2.	Eugene Island Blk. 208 OCS 0576 Platform "A" Continental Oil Co.	4-8-64 to 4-9-64	Struck by freighter; fire. B/E/	Fire control equipment.	2,559	Platform and freighter damaged. No recorded environmental damage.
3.	Ship Shoal Blk. 149 OCS 0434, Platform "B' Signal Oil & Gas Co.	10-3-64 (1 day)	Storage oil loss during hurricane. E/	Ceased	5,100	Platform destroyed. No recorded environmental damage.
4.	Ship Shoal Blk. 198 OCS 0594, Platform "A" Tenneco Oil Co.	10-3-64 (1 day)	Storage oil loss during hurricane. E/	Ceased	1,589	Platform destroyed. No recorded environmental damage.

A/ See also, Blowout, Table A
B/ See also, Explosions and Fires, Table B
C/ See also, Pipeline Leaks or Breaks, Table C
E/ See also, Major Accidents, Table E

EXHIBIT 1-1 (Sheet 7 of 7)

TABLE E

MAJOR ACCIDENTS CONNECTED WITH FEDERAL OIL AND GAS OPERATIONS IN THE OUTER CONTINENTAL SHELF GULF OF MEXICO

	Area and Block Lease & Well No. Operator	Date and Duration	Type Accident, Related Depth	How Controlled	Volume Oil Spilled" (bbls.)	Injuries, fatalities, damage to property or environment
1.	Vermilion Blk. 26 OCS 029, Well A-1 Union Oil Co. of Calif.	6-8-56 11%0-56	Blowout; Gas: A/ 11,435'. Fire. 13/	Drilled relief well	None	Lost 'platform, rig, and two wells.
2.	West Delta Blk. 45 OCS 0138, Platform "E", CAGC "	10-15-58 to 11-21-58	Explosion, fire; oil (completing) (Believed ignited by welding operation). B/	By last of 3 relief wells	Minimal .	Seven killed, 17 injured. Lost platform.
3.	So. Timbalier Blk. 134 Ocs 0461, Well D-1 Gulf Oil Corp.	7-26-59 (4 hrs ,)	Blowout, Gas; 4,880' Fire. A/B/	Bridged	None	One killed, seven injured; rig damaged.
4*	Eugene Island Blk. 199 OCS 0437, Well No. 2 Placid oil co.	7-13-60 to 7-27-60	Ship collided with jacket causing blowout; gas; fire A/B/	With blowout preventers.	None	Jacket-type platform destroyed. Well casing damaged.

A/ See also Blowouts, Table A
B/ See also Explosions and Fires, Table B
C/ See also Pipeline Leaks or Breaks, Table C
D/ See also Significant Pollution Accidents, Table D

EXHIBIT 1-2. GEOLOGICAL SURVEY - MONTHLY SUMMARY

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - CONSERVATION DEPARTMENT
GULF OF MEXICO OPERATIONS - O.C.S.
MONTHLY REPORT OF OPERATIONS
SALES AND DISPOSITION OF PRODUCTION
BY OPERATORS FOR SEPTEMBER, 1974

THIS REPORT CONTAINS ONLY LEASES ON WHICH THE U.S.G.S. HAS PRODUCTION CONTROL AUTHORITY

LEASE	LSEHLR	FIELD	OIL RUNS BARRELS	CONDES. RUNS BBL	GAS SOLD MCF	GAS FUEL MCF	GAS FLARE MCF	GAS INJ. MCF	TOTAL BBLS.RUN	TOTAL GAS PRODUCED
OPERATOR - FOREST										
G1979	FI287	FI292	0	713	1353955	457	0	0	713	1354412
G1980	FI307	FI292	0	713	204134	204	0	0	713	204338
G1981	FI314	FI292	0	65	418917	204	0	0	65	419121
G2082	VR268	VR255	0	720	107478	3239	0	0	720	110717
TOTALS - FOREST			20867	73395	12276036	51788	19318	0	94262	12347142
OPERATOR - GEN.AMERICAN										
0299	WC045	WC045	0	8645	9072	1634	0	0	8645	10706
0300	WC045	WC045	0	3392	303295	1800	0	0	3392	305095
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTALS - GEN.AMERICAN			11967	17782	854722	9000	0	0	29749	863722
OPERATOR - GULF										
0263	ST021	ST021	344388	0	268198	9922	140472	9438	344388	428030
0419	SS150	SS154	24913	0	2538	1694	97	0	24913	4329
0420	SS154	SS154	161007	0	15032	15022	574	10889	161007	41517
0453	SS140	SS154	2375	0	442	294	17	0	2375	753
0456	ST130	ST131	79047	2281	182115	5223	17477	0	81328	204815
0457	ST131	ST131	38084	5440	198048	2725	31424	0	43524	232197
0459	ST133	ST131	924	0	63	11	576	0	924	650
0461	ST134	ST135	40606	0	73399	7311	1581	0	40606	82291
0462	ST135	ST135	19000	5920	110454	1149	18249	0	24920	129852
0463	ST151	ST135	189016	779	143288	12512	44192	0	189795	199992
0464	ST152	ST135	36217	161	129709	2752	58108	0	36378	190569
0496	ST128	ST135	14501	1079	51911	1749	378	0	15580	54038
0774	SM023	SM023	15704	79177	3951799	19659	3592	0	94881	3975050
0786	SM049	SM048	30000	10848	1600782	4446	3209	0	40848	1608437
0820	SS169	SS169	619	6445	473322	3113	884	0	7064	477319

output complexity. It should be noted that the Southern California Conservation Division, being only responsible for five platforms at the present time, has not automated their platform inspection records. Efforts to standardize forms and procedures are underway. (Copies of Complex Initialization, Drilling and Production Inspection PING lists are provided in Exhibits 1-3, 1-4, and 1-5).

2.0 USE OF GS DATA

If Geological Survey permission is acquired to access the Conservation Division data base, the transfer of information from the GS facility to the BLM Center could be accomplished through a processor-to-processor direct access exchange initiated by a BLM Data Management System user at a regional remote site. This concept is illustrated in Figure 1-6, assuming a BLM facility in Washington, D. C. Technically, the data transfer is easily accomplished, given GS file naming and field length conversions.

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 1 of 6

```
DISTRICT _  COMPLEX ____            U.S. GEOLOGICAL SURVEY
LEASE ____                     PLATFORM INSPECTION SYSTEM                INPUT DATE __/ /.
DATE THIS INSP __/__/__           COMPLEX INITIALIZATION                 PAGE NO. __

    COMPLEX ID   AREA   BLOCK   LEASE   FIELD      COMPLEX STATUS:       CURRENT   COMPLEX SUMMARY
                                                     ABANDONED              _      *------ZONES------*
NEW  ______      __     ______  ______  _______      DRILLING               _                 CURRENT
                                                     PRODUCTION             _      PRODUCING
     *---------LEASE OPERATOR-----------* MILES   WATER DATE OF FIRST      WORKOVER        _        OIL         __
     CODE            NAME               TO SHORE DEPTH  PRODUCTION     MAJOR COMPLEX   _      PRODUCING
                                                                                              GAS         __
NEW  _   _______________  __________  _          __/__/__              GENERAL:               SHUT-IN
                                                                         HELIPORT         _         OIL         __
  STRUCTURE ID  NO.   NO.    SLOTS  *---COMPLETIONS---*  YEAR  YEAR      MANNED           _      SHUT-IN
USGS CO. NAME DECKS SLOTS DRILLED UNDER WTH SATELLITE INST REMOVED   PRODUCTION       _         GAS
                                                                           EQUIPMENT      _
NEW  __ _______  _   __   __   __      __        __    __            COMPRESSOR       _      *------WELLS------*
                                                                         FIRED VESSEL     _
                                                                         QUARTERS         _      TEMPORARY
NEW  _  _______  _   _    _    __      _         _     _             POWER            _         ABANDON        _
                                                                           GENERATION     _      PLUG &
                                                                         STORAGE TANKS    _         ABANDON     __
NEW  __ _______  _   __   __   __      __        __    __                                 _      GAS
                                                                       TYPE PRODUCTION:           INJECTED    __
NEW  _  _______  _   _    _    __      _         __    __              GAS              _      WATER
                                                                         OIL              _         INJECTED    __
                                                                         WATER            _      WATER
                                                                         CONDENSATE       _         SOURCE      __
NEW  _  _______  _   _    _    _       _         _     _                                         WATER
                                                                       METERING:                    DISPOSAL
                                                                         SALES.GAS        _
NEW  _  _______  _   _    _    _       _         _     _                 ALLOCATION
                                                                         LACT
                                                                         TANK GAUGE

                                                                       GAS FLARING
```

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 2 of 6)

DISTRICT _ COMPLEX _ _
LEASE ____
DATE THIS INSP _/__/_

U.S. GEOLOGICAL SURVEY
PLATFORM INSPECTION SYSTEM
COMPLEX INITIALIZATION

INPUT DATE __/__/__
PAGE NO. __

COMPLEX ID	AREA	BLOCK	LEASE	FIELD	LEASE OPERATOR	CO. REPRESENTATIVE
____	__	____	___	______	______________	__________

** TIME SUMMARY **

	CURRENT
INSPECTION	__.__ HR
WAITING	__.__ HR
TRAVEL	__.__ HR
TOTAL HR	__.__ HR

TYPE INSPECTION
CURRENT
--

Inspectors CODE CURRENT	INSPECTORS NAME - SIGNATURE
__	__________
__	__________
__	__________
__	__________

LINE NO.	STR NO.	WELL NUMBER OR ITEM NAME	ENFORCE ACTION	(NC NO.	*** ENFORCEMENT *---SHUT-IN---* DATE MO/DA/YR	TIME HR	ACTION *** *---REOPENED--* DATE MO/DA/YR	TIME HR	COMMENTS	LOST PRODUCTION OIL BARRELS	GAS MCF
01	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
02		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
03		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
04		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
05	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
06	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
07	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
08		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
09	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
10	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
11		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
12		________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
13	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
14	__	________	____	_____	__/__/__	__.__	__/__/__	__.__	________	____	____
15	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
16	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
17	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
18	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
19	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____
20	__	________	____	___.__	__/__/__	__.__	__/__/__	__.__	________	____	____

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 3 of 6)

DISTRICT COMPLEX ____
LEASE ____
OATE THIS INSP __/__/__

U.S. GEOLOGICAL SURVEY
PLATFORM INSPECTION SYSTEM
COMPLEX INITIALIZATION

INPUT OATE __/__/__
PAGE NO. __

** WAIVERS APPROVED **

LINE NO.	STRUCTURE NUMBER	PINC NUMBER	DATE ISSUED	COMMENTS
01	--	___.__	__/__/__	________________________________
02	--	___.__	__/__/__	________________________________
03	--	___.__	__/__/__	________________________________
04	--	___.__	__/__/__	________________________________
05	--	___.__	__/__/__	________________________________
06	--	___.__	__/__/__	________________________________
07	--	___.__	__/__/__	________________________________
08	--	___.__	__/__/__	________________________________
09	--	___.__	__/__/__	________________________________
10	--	___.__	__/__/__	________________________________
11	--	___.__	__/__/__	________________________________
12		___.__	__/__/__	________________________________
13	--	___.__	__/__/__	________________________________
14	--	___.__	__/__/__	________________________________
15	--	___.__	__/__/__	________________________________
16	--	___.__	__/__/__	________________________________
17	--	___.__	__/__/__	________________________________
18	--	___.__	__/__/__	________________________________
19	--	___.__	__/__/__	________________________________
20	--	___.__	__/__/__	________________________________

REMARKS 01 ________________________________ 02 ________________________________

REMARKS 03 ________________________________ 04 ________________________________

REMARKS 05 ________________________________ 06 ________________________________

REMARKS 07 ________________________________ 08 ________________________________

REMARKS 09 ________________________________ 10 ________________________________

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 4 of 6)

DISTRICT _ COMPLEX ----
LEASE ____
DATE THIS INSP _/_-/_-

U.S. GEOLOGICAL SURVEY
PLATFORM INSPECTION SYSTEM
COMPLEX INITIALIZATION

INPUT DATE _/_I _-
PAGE NO. --

LINE NO.	STRUC NO.	TYPE (D,I,B)	NAME/ SIZE	PROD (G,O)	DEPART TO	RECEIVES PRODUCT FROM FAC Y/N	INCOMING FROM	DELIVERS PRODUCT TO FAC Y/N	PIPELINES — PIPELINE SENSOR — OPERATING RANGE — RECORD HIGH	RECORD LOW	TEST HIGH	TEST LOW	SHUTS WELL Y/N	PIPELINE HIGH SET PSI	PUMP LOW SET PSI	AUTO OPERABLE Y/N	S.I. VALVE ACTIVATED BY AUTO Y/N	S.I. VALVE ACTIVATED BY INO REM Y/N	CHECK VALVE Y/N
01																			
02																			
03																			
04																			
05																			
06																			
07																			
08																			
09																			
10																			

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 5 of 6)

DISTRICT _ COMPLEX ___
LEASE - - - -
DATE THIS INSP __/__/__

U.S. GEOLOGICAL SURVEY
PLATFORM INSPECTION SYSTEM
COMPLEX INITIALIZATION

INPUT DATE __/__/__
PAGE NO. --

WELL BAY AND FIELD RECORDS

LINE NO.	STRUC No.	WELL ID	ZONE STAT	SIN Y/N	NO. MAS VAL	THG PRESS PSI FLO	SI	CASING PSI	TREE PSI	WORKING PRESS FLOW LINES HEADER	*---PRESSURE SENSOR---* *--RECORD--* HIGH	LOW	*--TEST---* HIGH	LOW	SSV TST H/L	CHK VAL H/L	TBG INST 12/72	*----SUBSURFACE MAKE MOD TYPE	DEPTH SET	SAFETY DEVICE----* DATE REM/INST	WA-LAND Y/N	FLO NIP Y/N	CUP Y/N	AVG DAILY PROD RATE
01																								
02																								
03																								
04																								
05																								
06																								
07																								
08																								
09																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								

EXHIBIT 1-3. COMPLEX INITIALIZATION (Sheet 6 of 6)

DISTRICT __ COMPLEX ____
LEASE ____
DATE THIS INSP __/__/__

U. S. GEOLOGICAL SURVEY
PLATFORM INSPECTION SYSTEM
COMPLEX INITIALIZATION

INPUT DATE __/__/__
PAGE NO. __

PRODUCTION VESSELS

LINE NO.	STRUC NO.	*------VESSEL NAME ------*	WORKING PRESSURE PSI	OPERATING RANGE (PSI) HIGH	OPERATING RANGE (PSI) LOW	*----PRESSURE SENSOR---* *--RECORD--* HIGH	*--RECORD--* LOW	*--- TEST--* HIGH	*--- TEST--* LOW	OPERABLE LEVEL SHUT-IN (Y/N) HIGH	OPERABLE LEVEL SHUT-IN (Y/N) LOW	RELIEF VALVE SET (PSI)	W.P. SEP INLET V. (PSI)	DISCHARGE TO FLARE (Y/N)
01														
02														
03														
04														
05														
06														
07														
08														
09														
10														
11														
12														
13														
14														
15														
16														
17														

EXHIBIT 1-4. DRILLING INSPECTION PINC LIST
(Sheet 1 **of** 5)

DISTRICT _ RIG ID NO ____ DATE OF INS._/__/_ TYPE INSP. _

DRILLING Inspection PINC LIST

ENF.	INC #	PART I GENERAL PINC DESCRIPTION	C	#CK	#Y	#N	#NA
W	65.0	IS RIG OR PLATFORM PROPERLY IDENTIFIED?	W				
W	66.0	FOR ALL PERSONNEL ON RIG ARE THERE SUFFICIENT: LIFE JACKETS AND LIFE RAFTS? (MAX. # PERSONNEL)	W				
Z	68.0	ARE ELECTRICAL GENERATORS, MOTORS, LIGHTING SYSTEM INSTALLED, PROTECTED, AND MAINTAINED IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE, API RP 500A-B?	Z				
W/Z	1.0	IS FACILITY EQUIPPED WITH NECESSARY CURBS, GUTTERS AND DRAINS OR DRIP PANS?	W Z				
Z	2.0	ARE ALL DRAINS PIPED TO A TANK OR SUMP WHICH WILL MAINTAIN OIL AT A LEVEL TO PREVENT DISCHARGE INTO THE GULF WATERS, OR HAS AN ALTERNATE METHOD BEEN APPROVED?	Z				
Z	4.0	IS OPERATOR NOT DISPOSING OF OIL, OILY SOLIDS, OR DRILLING MUD CONTAINING OIL INTO THE WATERS OF THE GULF?	Z				
Z	5.0	IS OPERATOR NOT DISPOSING OF DRILLING MUD CONTAINING TOXIC SUBSTANCES INTO GULF WATER WITHOUT NEUTRALIZATION?	Z				
Z	6.0	IS OPERATOR NOT DISPOSING OF LIQUID WASTE MATERIALS CONTAINING HARMFUL SUBSTANCES INTO GULF WATERS WITHOUT NEUTRALIZATION?	Z				
W	7.0	ARE SOLID WASTE MATERIALS INCINERATED OR TRANSPORTED TO SHORE? (UNDERLINE METHOD)	W				
W	8.0	IS POLLUTION INSPECTION MADE DAILY?	W				
W	14.0	DO OPERATORS NOTIFY EACH OTHER UPON OBSERVATION OF EQUIPMENT MALFUNCTION OR POLLUTION RESULTING FROM ANOTHER'S OPERATION?	W				
W	10.0	ARE SPILLS AND LEAKS RECORDED AND RECORDS AVAILABLE FOR INSPECTION?	W				
Z	16.0	IS SEWAGE DISPOSAL SYSTEM INSTALLED?	Z				
W/Z	17.0	DOES EFFLUENT CONTAIN 50 MG/LITER OR LESS OF BOD, 150 MG/LITER OR LESS OF SUSPENDED SOLIDS, MINIMUM CHLORINE RESIDUAL OF 1.0 MG/LITER AFTER MINIMUM RETENTION TIME OF 15 MINUTES?	W Z				

	SIZE HOLE	CASING SIZE	GRADE	WT/FT	INT. YLD.	SET AT	W/ SX. CEM.	BOND LOG ?	REM. ACT. ?	PRESS PSI	TEST TIME	WOC TIME
DR. /STRUC	X		X		X		X	X	X	X	X	X
COND.												
SUR.												
INTER.												
PROD.												
LINER												

APPROVED - FROM DISTRICT FILE

	SIZE HOLE	SIZE	GRADE	WT/FT.	INT. YIELD	SET AT	SX. CEMENT
DR /STRUC	X		X		X		X
COND.							
SUR.							
INTER.							
PROD.							
LINER							

EXHIBIT 1-4. DRILLING INSPECTION PINC LIST
(Sheet 2 of 5)

ENF.	INC #	PART II CASING/MUD PROGRAM PINC DESCRIPTION					
Z	28.0	WAS APPROPRIATE REMEDIAL ACTION TAKEN, IF SURFACE CASING DID NOT CEMENT PROPERLY?	Z				
Z	31.0	WAS LINER SEAL PRESSURE TESTED AND TEST RESULTS RECORDED IN LOG?	Z				
Z	32.0	HAVE CASING STRINGS BEEN PRESSURE TESTED?	Z				
W	33.0	WERE TEST RESULTS RECORDED IN DRILLER'S LOG?	W				
Z	34.0	WAS REMEDIAL ACTION TAKEN IF NEEDED?	Z				
Z	35.0	WAS THERE PROPER WOC TIME BEFORE DRILLING OUT?	Z				
Z	36.1	ARE DAILY INVENTORIES OF MUD MATERIALS TAKEN, RECORDED AND USED AS A BASIS FOR DETERMINING MINIMUM QUANTITIES OF MUD NEEDED?	Z				
Z	36.2	ARE THESE MINIMUM QUANTITIES OF MUD MAINTAINED?	Z				
Z	38.0	HAS MUD BEEN PROPERLY CONDITIONED BY CIRCULATION BEFORE STARTING OUT OF THE HOLE OR IS THERE PROPER DOCUMENTATION IN DRILLER'S LOG THAT CIRCULATION WAS NOT NECESSARY? (UNDERLINE WHICH)	Z				
Z	39.0	IS ANNULUS FILLED BEFORE MUD LEVEL DROPS 100 FT?	Z				
Z	40.0	IS MECHANICAL DEVICE USED TO MEASURE MUD TO FILL HOLE?	Z				
Z	41.0	WAS PROCEDURE IN OCS ORDER 2 USED IF SWABBING OR FLUID INFLUX INDICATED?	Z				

LAST TIME EVENT OCCURRED?	WHAT OCCURRED?
RECORDED IN LOG?	DEPTH?

Z	42.0	IS MUD TESTING EQUIPMENT ON FACILITY?	Z				
Z	43.0	ARE MUD TESTS PERFORMED DAILY, OR AS WARRANTED?	Z				

FROM FIELD INFORMATION				APPROVED - FROM FILE		
DEPTH	MUD WEIGHT	VISCOSITY	TYPE/BASE	MUD WEIGHT	VISCOSITY	TYPE/BASE

Z	44.0	ARE MUD TESTS RECORDED IN DRILLER'S LOG?	Z				
Z	45.0	IS RECORDING MUD PIT LEVEL INDICATOR INSTALLED AND USED?	Z				
Z	46.0	IS AUDIO OR VISUAL WARNING ON PIT LEVEL INDICATOR INSTALLED AND USED?	Z				
Z	48.0	IS MUD RETURN INDICATOR INSTALLED AND USED?	Z				
Z	197.0	IS AN OPERABLE DEGASSER INSTALLED AND MAINTAINED FOR USE AT ALL TIMES?	Z				
Z	198.0	IS AN OPERABLE GAS DETECTOR INSTALLED TO MONITOR DRILLING MUD RETURNS?	Z				
Z	199.0	HAS FILLUP VOLUME REQUIRED TO FILL HOLE ON TRIPS BEEN CALCULATE AND POSTED?	Z				

ENF.	INC #	PART III DRILLING SAFETY EQUIPMENT PINC	C	#CK	# Y	#N	#NA
Z	195.0	IS HYDRAULICALLY CONTROLLED ANNULAR BOP OR PRESSURE-ROTATING PACK-OFF TYPE HEAD INSTALLED ON THE DRIVE PIPE? (UNDERLINE WHICH)	Z				
Z	49.0	IS HYDRAULICALLY CONTROLLED ANNULAR BOP INSTALLED ON CONDUCTOR CASING?	Z				
Z	50.1	IS DIVERTER SYSTEM AS DESCRIBED IN OCS ORDER 2, SECTION 2.A. INSTALLED ON THE DRIVE OR STRUCTURAL CASING?	Z				
Z	50.2	IS DIVERTER SYSTEM AS DESCRIBED IN OCS ORDER 2, SECTION 2.11 INSTALLED ON CONDUCTOR CASING?	Z				

EXHIBIT 1-4. DRILLING INSPECTION PINC LIST
(Sheet 3 of 5)

INF.	INC #	PART II CASING/MUD PROGRAM (CONTINUED)	C	#CK	#Y	#N	#NA
Z	50.3	IN FLOATING DRILLING OPERATIONS WHERE PLACEMENT OF INITIAL STRUCTURAL CASING WILL NOT PROVIDE ADEQUATE FORMATION COMPETENCE TO SAFELY CONTAIN HYDROCARBONS WHILE DRILLING CONDUCTOR HOLE, HAS A PROGRAM PROVIDING FOR RIG AND PERSONNEL SAFETY DURING THESE OPERATIONS BEEN SUBMITTED TO AND APPROVED BY THE DISTRICT SUPERVISOR?	Z				
Z	50.4	IF SHALLOW HAZARDS ARE UNKNOWN, WAS SEISMIC DATA OBTAINED AND A SMALL DIAMETER PILOT HOLE DRILLED FROM BOTTOM OF DRIVE PIPE TO CONDUCTOR CASING SEAT?	Z				
Z	50.5	IS AN OPERABLE REMOTE BOP CONTROL STATION PROVIDED IN ADDITION TO THE ONE ON THE RIG FLOOR?	Z				
Z Z	52.1 53.1	ARE REMOTELY CONTROLLED, HYDRAULICALLY OPERATED BLOWOUT PREVENTERS INSTALLED?	Z				
Z Z	52.3 53.3	IS CHOKE LINE AND MANIFOLD INSTALLED?	Z				
Z Z	52.4 53.4	IS KILL LINE INSTALLED?	Z				
Z Z	52.5 53.5	IS FILL-UP LINE INSTALLED?	Z				
Z	51.0	IF THE BOP IS ON THE GULF FLOOR, ARE THE CHOKE AND KILL LINES EQUIPPED TO PERMIT THE DIVERSION OF HYDROCARBONS AND OTHER FLUIDS?	Z				
		WP OF STACK | DATE OF LAST TEST | TEST PRESS.					
W	200.0	FOR EACH CASING STRING, HAS THE MAXIMUM PRESSURE TO BE APPLIED TO BOP DURING WELL CONTROL OPERATIONS BEEN POSTED?	W				
Z	61.0	IS THE ANNULAR BLOW-OUT PREVENTER TESTED WITH WATER TO 70% OF WP OF STACK?	Z				
Z	62.0	IS THE ANNULAR BLOW-OUT PREVENTER ACTUATED ON DRILL PIPE WEEKLY?	Z				
W	64.1	IS TEST INFORMATION FOR ALL BLOW-OUT PREVENTOR TESTS RECORDED IN DRILLER'S LOG?	Z				
		IS BOP TESTED WITH WATER TO WP OF STACK ASSEMBLY:					
Z	59.1	WHEN INITIALLY INSTALLED?	Z				
Z	59.2	BEFORE DRILLING OUT AFTER EACH CASING STRING IS SET?	Z				
Z	59.3	NOT LESS THAN ONCE EACH WEEK FROM EACH OF THE CONTROL STATIONS?	Z				
Z	59.4	FOLLOWING REPAIRS THAT REQUIRE DISCONNECTING A PRESSURE SEAL?	Z				
Z	60.0	ARE PIPE RAMS ACTUATED EACH TRIP, AT LEAST DAILY?	Z				
Z	196.0	ARE BLIND RAMS ACTUATED EACH TRIP, AT LEAST DAILY?	Z				
Z	54.0	ARE THERE ACCUMULATORS OR ACCUMULATORS AND PUMPS TO REPEATEDLY OPERATE BOP?	Z				
		DIFFERENT SIZE(S) OF DRILL PIPE					
Z	57.0	ARE INSIDE BOP ASSEMBLY AND DRILL STRING SAFETY VALVES TO FIT ALL SIZES OF PIPE IN THE DRILL STRING MAINTAINED IN THE OPEN POSITION ON THE RIG FLOOR?	Z				
Z	58.0	IS KELLY COCK INSTALLED BELOW SWIVEL AND ESSENTIALLY FULL OPENING KELLY COCK INSTALLED AT BOTTOM OF KELLY?	Z				
		KELLY COCK WRENCH? | Y | N | WHERE LOCATED?					
Z	[illegible]	BOP DRILL CONDUCTED WEEKLY FOR EACH CREW?	Z				
W	64.2	IS BOP DRILL RECORDED IN DRILLER'S LOG?	W				

EXHIBIT 1-4. DRILLING INSPECTION PINC LIST
(Sheet 4 of 5)

ENF.	INC #	PART III DRILLING SAFETY (CONTINUED)	C	CK	Y	#N	#NA
Z	1201.0	IS THE WELL CONTINUOUSLY UNDER SURVEILLANCE UNLESS SECURED WITH BOP OR CEMENT PLUG?	Z				
Z	1202.1	HAVE COMPANY AND DRILLING CONTRACTOR PERSONNEL BEEN TRAINED IN WELL CONTROL AND ABNORMAL PRESSURE DETECTION?	Z				
Z	1202.2	IS RECORD OF TRAINING MAINTAINED ON FACILITY?	Z				
Z	1203.0	AFTER DRILLING 100 FT. BELOW SURFACE CASING, HAS PRESSURE TEST BEEN OBTAINED ANO RECORDED?	Z				
Z	1204.0	HAVE INCLINATION ANO DIRECTIONAL SURVEYS BEEN OBTAINED ANO FILED AS REQUIRED IN OCS ORDER 2, SECTION 1.F?	Z				
Z	1205.0	DID WELL DESIGN CRITERIA CONSIDER ALL FACTORS SUCH THAT THE WELL BORE COULD BE EXPECTED TO WITHSTAND A 0.5 PPG KICK?	Z				

ENF.	INC #	PART IV HYDROGEN SULFIDE	C	CK	Y	#N	#NA
		IF THIS WELL WILL PENETRATE RESERVOIRS KNOWN OR EXPECTED TO CONTAIN HYDROGEN SULFIDE OR IF IT HAS ENCOUNTERED HYDROGEN SULFIDE, THE FACILITY SHALL BE INSPECTED FOR THE FOLLOWING:					
Z	1206.0	WERE PERSONNEL INFORMED OF HAZARDS OF H2S AND SO2 AND INSTRUCTED IN PROPER USE OF SAFETY EQUIPMENT ANO PROCEDURES?	Z				
Z	1207.0	IS INFORMATION REGARDING H2S SAFETY MEASURES PROMINENTLY POSTED ON FACILITY AND VESSELS SERVING THE FACILITY?	Z				
Z	1208.0	HAS A WEEKLY H2S DRILL ANO TRAINING SESSION BEEN HELD ANO RECORDS OF ATTENDANCE RECORDED?	Z				
Z	1209.0	HAVE ALL PERSONNEL BEEN INDROCTRINATED IN BASIC H2S FIRST-AID PROCEDURES?	Z				
		IS THE FOLLOWING SAFETY EQUIPMENT AVAILABLE FOR USE:					
Z	1210.1	PROTECTIVE BREATHING APPARATUS FOR ALL PERSONNEL ON THE FACILITY OR ABOARD MARINE VESSELS SERVING THE FACILITY?	Z				
Z	1210.2	RESUSCITATORS, COMPLETE WITH FACE MASKS, OXYGEN BOTTLES AND SPARE OXYGEN BOTTLES?	Z				
Z	1210.3	A SYSTEM OF BREATHING AIR MANIFOLDS, HOSES, AND MASKS ON THE RIG FLOOR AND IN THE BRIEFING AGE AS?	Z				
Z	1210.4	A CASCADE AIR-BOTTLE SYSTEM TO REFILL INDIVIDUAL PROTECTIVE BREATHING APPARATUS BOTTLES?	Z				
Z	1211.1	FIRST AID KIT?	Z				
Z	1211.2	STOKES LITTER OR EQUIVALENT?	Z				
Z	1211.3	PORTABLE H2S DETECTORS?	Z				
Z	1211.4	RETRIEVAL ROPES WITH SAFETY HARNESS?	Z				
Z	1211.5	CHALK BOARDS AND NOTE PADS ON THE RIG FLOOR, IN THE SHALE SHAKER AREA AND IN THE CEMENT PUMP ROOM?	Z				
Z	1211.6	BULL HORNS?	Z				
Z	1211.7	FLASHING LIGHTS?	Z				
Z	1211.8	H2S DETECTOR AMPULES?	Z				
Z	1213.0	IS WIND DIRECTION EQUIPMENT INSTALLED?	Z				
Z	1214.0	ARE OPERATIONAL DANGER SIGNS ANO RED FLAGS AVAILABLE FOR USE?	Z				
Z	1215.0	HAS CONTINGENCY PLAN BEEN DEVELOPED PRIOR TO COMMENCEMENT OF DRILLING OPERATIONS?	Z				
		IS H2S DETECTION AND MONITORING EQUIPMENT INSTALLED WITH SENSING POINTS AT THE FOLLOWING LOCATIONS:					
Z	1216.1	BELL NIPPLE?	Z				
Z	1216.2	SHALE SHAKER?	Z				
Z	1216.3	MUD PITS?	Z				
Z	1216.4	DRILLER'S STAND?	Z				
Z	1216.5	LIVING QUARTERS?	Z				
Z	1216.6	OTHER AREAS WHERE H2S MIGHT ACCUMULATE?	Z				

EXHIBIT 1-4. DRILLING INSPECTION PINC LIST
(Sheet 5 of 5)

DRILLING INSPECTIO PA E 5

ENF.	INC #	PART IV HYDROGEN SULFIDE (CONTINUED)	C	#CK	#Y	#N	#NA
Z	217.0	HAVE SAFE BRIEFING AREAS BEEN DESIGNATE?	Z				
Z	218.0	ARE ALL VENTILATION DEVICES EXPLOSION PROOF?	Z				
Z	219.1	ARE OR ILL STRINGS CASING, WELLHEAD, BOP ANO RELATED EQUIPMENT DESIGNED FOR H2S SERVICE?	Z				
Z	219.2	DOES TOOL JOINT COMPOUND BEING USEO NOT CONTAIN FREE SULPHER?	Z				
Z	220.0	IS THE PH OF WATER BASE MUD SYSTEMS MAINTAINED AT 10.0 OR GREATER?	Z				
Z	221.0	ARE SUFFICIENT ADDITIVES FOR NEUTRALIZATION OF H2S AVAILABLE?	Z				
Z	222.0	IS GAS FROM THE MUO DEGASSER PIPED TO A CLOSED FLARE SYSTEM FOR BURNING AT A SUITABLE REMOTE STACK?	Z				
Z	223.0	IS THE H2S FLARE SYSTEM EQUIPPED WITH A PILOT, AUTOMATIC IGNITER AND BACKUP IGNITER?	Z				
Z	224.0	ARE GENERAL OPERATIONS, INCLUDING ORILLING, TRIPPING, CIRCULATING, FISHING, LOGGING, CORING ANO STRIPPING PERFORMED IN ACCORDANCE WITH THE PROVISIONS OF OCS OROER 2, SECTION 5.0 (PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT)?	Z				
Z	225.1	ARE THE WELL OPERATIONS CARRIED ON IN A MANNER TO MINIMIZE THE POSSIBILITY OF A KICK?	Z				
Z	225.2	IS THE DISPOSAL OF WELL INFLUX FLUIDS FROM A KICK EITHER BY PUMPING THE FLUIDS BACK INTO THE FORMATION OR BY USING APPROPRIATE WELL CONTROL TECHNIQUES?	Z				
Z	226.0	IS WELL TESTING PERFORMED WITH A MINIMUM NUMBER OF PERSONNEL IN THE IMMEDIATE VICINITY?	Z				
Z	227.0	IS A SPECIAL SAFETY MEETING CONOUCTEO BEFORE WELL TESTING?	Z				
Z	228.0	ARE ALL GASES PRODUCED VENTED THROUGH THE FLARE SYSTEM AND BURNED?	Z				
Z	229.0	ARE NO SMOKING RULES RIGOROUSLY ENFORCEO?	Z				
Z	230.0	OOES TUBING, WELLHEAD EQUIPMENT ANO TEST TOOL USEO FOR TESTING MEET THE REQUIREMENT FOR H2S SERVICE?	Z				
Z	231.0	IS TEST STRING FLUSHED WITH TREATEO FLUID AFTER THE TEST?	Z				
Z	232.0	IS SURFACE TEST EQUIPMENT SUITABLE FOR H2S SERVICE?	Z				

EXHIBIT 1-5. PRODUCTION INSPECTION PINC LIST
(Sheet 1 of 3)

DISTRICT _ COMPLEX ____ DATE OF INSP. __/__/__ TYPE INSP. _

PRODUCTION INSPECTION PINCLIST*

ENF.	PINC #	PART I GENERAL PINC DESCRIPTION	C	#CK	#Y	#N	#NA
W	139.0	IS STRUCTURE PROPERLY IDENTIFIED?	W				
		FOR ALL PERSONNEL ON THE PLATFORM ARE THERE:					
P	140.1	SUFFICIENT LIFE JACKETS? (# PERSONS ON BOARD)	P				
P	140.2	SUFFICIENT LIFE RAFTS? (ON MANNED PLATFORM)	P				
P	143.0	IS THERE AN AUXILIARY ELECTRICAL POWER SUPPLY?	P				
P(2)	144.0	ARE ELECTRICAL GENERATORS, MOTORS, LIGHTING SYSTEM INSTALLED, PROTECTED, MAINTAINED IN ACCORDANCE WITH SEC. API RP 500A-B?	V				
P(2)	145.0	ARE GAS ENGINES EQUIPPED WITH LOW-TENSION IGNITION SYSTEMS, RIGID CONNECTIONS, SHIELDED WIRING?	V				
W/P (1)	1.0	IS PLATFORM EQUIPPED WITH NECESSARY CURBS, GUTTERS AND DRIP PANS PROPERLY PIPED TO SUMPS?	W U				
P	2.01	DOES SUMP AUTOMATICALLY MAINTAIN OIL AT A LEVEL TO PREVENT DISCHARGE INTO THE GULF WATERS, OR HAS AN ALTERNATE METHOD BEEN APPROVED? (# SUMPS)	P				
P	4.0	IS OPERATOR NOT DISPOSING OF OIL, OILY SOLIDS OR OTHER HARMFUL WASTE MATERIAL INTO GULF?	P				
P(2)	15.0	IS SEWAGE DISPOSAL SYSTEM INSTALLED?	V				
P(2)	17.1	DOES EFFLUENT CONTAIN 50 PPM OR LESS OF 200.150 PPM OR LESS OF SUSPENDED SOLIDS, MIN. CHLORINE RESIDUAL OF 1.0 MG/LITER AFTER MIN. RETENTION TIME OF 15 MIN?	V				
		IS FUSIBLE MATERIAL USED IN PNEUMATIC LINES AT THE FOLLOWING STRATEGIC LOCATIONS?					
P(2)	141.1	WELL HEADS	V				
P (2)	1141.21	PROD VESSELS	V				
P(2)	141.3	PUMPS, ENGINES, GENERATORS	V				
P(2)	141.4	OTHER STRATEGIC LOCATIONS	V				
		ARE REMOTE SHUT-IN CONTROLS QUICK OPENING AND AT THE FOLLOWING STRATEGIC LOCATIONS?					
P	1129.11	HELICOPTER DECK	P				
P	129.2	EXIT STAIRWAY	P				
P	129.3	ON EACH BOAT LANDING	P				
P	129.4	OTHER STRATEGIC LOCATIONS	P				
W	150.0	IS THE DIAGRAM FOR FIRE FIGHTING AND GAS DETECTION SYSTEMS, AND STANDARD PROCEDURE FOR TESTING SAFETY EQUIPMENT POSTED IN PROMINENT PLACE? (UNDERLINE ITEMS WHICH ARE NA)	W				
		ARE FIRE EXTINGUISHERS LOCATED IN THE FOLLOWING STRATEGIC LOCATIONS?					
		STRATEGIC AREA | SIZE | TYPE | COND. | DATE CHKD					
P	151.1	WELL	P				
P	151.2	PRODUCTION	P				
P	151.3	COMPRESSOR	P				
P	151.4	GENERATOR	P				
P	151.5	PUMP	P				
P	151.6	LIVING QUARTERS	P				
P	1151.71	OTHER	P				
P	153.1	FIREWATER SYSTEM OF RIGID PIPE OR CHEMICAL SYSTEM IN PRODUCTION HANDLING AREA?	P				
P	153.2	IF CHEMICAL SYSTEM IS USED IN LIEU OF WATER SYSTEM, HAS APPROVAL BEEN GRANTED?	P				
P	154.0	IS THERE AN ALTERNATE FUEL OR POWER SOURCE TO PROVIDE CONTINUED FIREWATER SYSTEM PUMP OPERATION OR ALTERNATE FIREFIGHTING SYSTEM?	P				
W	1155.01	ARE FIREWATER SYSTEM PUMPS TESTED WEEKLY AND TEST RECORDS MAINTAINED IN FIELD?	W				
P	158.0	IS A CONTINUOUS MONITORING GAS DETECTION SYSTEM LOCATED IN ENCLOSED AREA CONTAINING GAS HANDLING FACILITIES OR EQUIPMENT? (# SUCH AREAS)	P				
P	1160.01	DOES GAS DETECTION SYSTEM SOUND ALARM BELOW LOWER EXPLOSIVE LIMIT OF 1.3% AND TRIGGER SHUT-IN SEQUENCES TO OPERATE EMERGENCY EQUIPMENT WHEN LEVELS REACH NOT MORE THAN 4.9%? (4.9% OF LEL)	P				

EXHIBIT 1-5. PRODUCTION INSPECTION PINC LIST
(Sheet 2 of 3)

ENF.	INC #	PART II PLATFORM PIPELINE PINC DESCRIPTION	C	#CK	#Y	#N	#NA
		ARE DEPARTING PIPELINES EQUIPPED WITH: (NOT LESS THAN TWO TIMES # DEPARTING LINES)					
PL	1.23.1	OPERABLE HIGH AND LOW PRESSURE SENSORS?	L				
PL	123.2	HIGH AND LOW PRESSURE SENSORS OF SIGNED TO S.I. WELLS IF PRODUCTION RECEIVED FROM PLATFORM?	L				
P(2)	127.1	ARE PIPELINE PUMPS EQUIPPED WITH OPERABLE Hi-Lo PRESSURE SENSORS? (TWO (X) # OF PUMPS)	V				
		ARE INCOMING PIPELINES EQUIPPED WITH:					
PL	124.1	OPERABLE AUTOMATIC SHUT-IN VALVE ACTUATED BY PLATFORM AUTOMATIC AND REMOTE SHUT-IN SYSTEM IF PRODUCTION DELIVERED TO PLATFORM? (# INCOMING LINES DELIVERING PRODUCTION)	L				
PL	124.2	OPERABLE AUTOMATIC SHUT-IN VALVE ACTUATED BY PLATFORM OR INDEPENDENT REMOTE SHUT-IN SYSTEM IF PRODUCTION NOT DELIVERED TO PLATFORM? (# INCOMING LINES NOT DELIVERING PRODUCTION)	L				
PL	124.3	CHECK VALVE? (# INCOMING LINES)	L				
		ARE BI-DIRECTIONAL PIPELINES EQUIPPED WITH:					
PL	125.1	OPERABLE HI AND LOW PRESSURE SENSORS? (# BI-DIRECTIONAL LINES)	L				
PL	125.2	HI AND LOW PRESSURE SENSORS DESIGNED TO SHUT-IN WELLS IF PRODUCTION RECEIVED FROM PLATFORM? (# BI-DIRECTIONAL LINES RECEIVING PRODUCTION)	L				
PL	125.3	OPERABLE AUTOMATIC SHUT-IN VALVE ACTUATED BY PLATFORM AUTOMATIC AND REMOTE SHUT-IN SYSTEM IF PRODUCTION DELIVERED TO PLATFORM? (# BI-DIRECTIONAL LINES DELIVERING PRODUCTION)	L				
PL	125.4	OPERABLE AUTOMATIC SHUT-IN VALVE ACTUATED BY PLATFORM OR INDEPENDENT REMOTE SHUT-IN SYSTEM IF PRODUCTION NOT DELIVERING TO PLATFORM? (# BI-DIRECTIONAL LINES NOT DELIVERING PRODUCTION)	L				

ENF.	INC #	PART III WELL BAY AREA PINC DESCRIPTION	C	#CK	#Y	#N	#NA
W	98.0	IS EACH COMPLETION IDENTIFIED AT WELLHEAD?	W				
Z	93.0	DO WELLHEADS HAVE A RATED WORKING PRESSURE GREATER THAN THE SURFACE SHUT-IN PRESSURE(S) (# OF X-MAS TREES)	Z				
Z	95.0	ARE 2 MASTER VALVES INSTALLED ON TUBING IF SURFACE PRESSURE IS IN EXCESS OF 5000 PSI? (# OF ZONES WITH SURFACE PRESSURE > THAN 5000 PSI)	Z				
W	97.01	ARE WELLS WITH SUSTAINED CASING-HEAD PRESSURE TESTED IN ACCORDANCE WITH OCS ORDER 6.1. B?	W				
Z	99.01	ARE ZONES CAPABLE OF PRODUCING (NOT BLIND-FLANGED OR PLUGGED) EQUIPPED WITH AN OPERABLE AUTOMATIC FAILCLOSE VALVE?	Z				
Z	105.0	ARE HEADERS EQUIPPED WITH PROPERLY SEALING CHECK VALVES ON INDIVIDUAL FLOWLINES OF ZONES CAPABLE OF PRODUCING? (# OF ZONES NOT BLIND-FLANGED OR PLUGGED)	Z				
Z	100.0	ARE FLOWLINES OF ZONES CAPABLE OF PRODUCING (NOT BLIND-FLANGED OR PLUGGED) EQUIPPED WITH HIGH-LOW PRESSURE SENSORS SET TO ACTIVATE AUTOMATIC VALVE IN THE EVENT OF ABNORMAL HIGH AND LOW PRESSURES? (NOT LESS THAN TWO (X) # APPLICABLE FLOWLINES)	Z				
Z	1101.01	ARE MANUALLY OPENED AUTOMATIC VALVES FLAGGED? (# OF MANUALLY OPENED SURFACE SAFETY VALVES)	Z				
Z	106.0	DO ALL FLOWLINES AND HEADERS EITHER WITHSTAND SHUT-IN WELLHEAD PRESSURE OR HAVE A RELIEF VALVE BY-PASS? (# ZONES NOT BLIND-FLANGED OR PLUGGED)	Z				

ENF.	INC #	PART IV PRODUCTION VESSELS PINC DESCRIPTION	C	#CK	#Y	#N	#NA
		ARE PRESSURE VESSELS EQUIPPED WITH:					
P(2)	110.1	OPERABLE HIGH PRESSURE SENSOR SET NO HIGHER THAN 5% BELOW WORKING PRESSURE (OR 5 PSI WHERE APPLICABLE)?	V				
P(2)	110.2	OPERABLE LOW PRESSURE SENSOR SET NO LOWER THAN 10% BELOW THE LOWEST OPERATING PRESSURE (OR 5 PSI WHERE APPLICABLE)?	V				
P(2)	110.3	OPERABLE HIGH-LEVEL SHUT-IN?	V				
P(2)	110.4	OPERABLE LOW-LEVEL SHUT-IN?	V				
P(2)	110.5	OPERABLE RELIEF VALVES SET NO HIGHER THAN VESSEL WORKING PRESSURE? (# PRESSURE OPER. VESSELS?)	V				

EXHIBIT 1-5. PRODUCTION INSPECTION PINC LIST
(Sheet 3 of 3)

ENF.	INC #	PART IV (CONTINUED)	C	#CK	#Y	#N	#NA
P(2)	114.0	DOES INLET VALVE TO SEPARATOR AND LINE FROM HEADER TO VALVE WITHSTAND SI WELLHEAD PRESSURE. IF UNPROTECTED BY RELIEF VALVE?	V				
P(2)	117.0	IS FLARELINE EQUIPPED WITH SCRUBBER?	V	1			
P(2)	119.0	ARE ATMOSPHERIC VESSELS EQUIPPED WITH OPERABLE HIGH-LEVEL SHUT-IN CONTROLS? (INCLUDES FLARE SCRUBBERS, STOCK, SUMP, AND SURGE TANKS, ETC.)	V				

ENF.	INC #	PART V FIELD RECORDS PINC DESCRIPTION	C	#CK	#Y	#N	#NA
Z	130.0	IS EACH TUBING INSTALLATION OPEN TO HYDROCARBON ZONES EQUIPPED WITH AN OPERABLE SUBSURFACE SAFETY DEVICE (SSSV OR PLUG) SET AT LEAST 100 FT BELOW GULF FLOOR? (COUNT WAIVERS AS NA)	Z				
Z	132.0	ARE SUBSURFACE SAFETY DEVICES AVAILABLE FOR ALL ZONES NOT SO EQUIPPED AND SUCH ZONES CLEARLY IDENTIFIED AND ATTENDED WHILE PRODUCING? (# OF SUCH ZONES)	Z				
W	193.0	IS EACH ZONE SHUT-IN 6 MONTHS OR LONGER EQUIPPED WITH A PUMP-THROUGH TUBING PLUG? (# SUCH ZONES)	W				
Z	133.0	HAS EACH SURFACE CONTROLLED DEVICE & TUBING PLUG BEEN TESTED FOR HOLDING PRESSURE (AT 6 MONTHS INTERVALS)?	Z				
Z	136.0	HAS SUBSURFACE CONTROLLED DEVICES BEEN INSPECTED AT 6 MONTHS OR 12 MONTHS INTERVALS AS APPROPRIATE? (# OF SUCH DEVICES)	Z				
Z	134.0	IS EACH TUBING INSTALLATION EQUIPPED WITH LANDING NIPPLES AND FLOW-COUPLING IF COMPLETED AFTER R-28-69? (# OF SUCH)	Z				
Z	194.0	WHERE SUBSURFACE SAFETY DEVICES HAS BEEN REMOVED FOR MORE THAN FIFTEEN DAYS HAS APPROVAL BEEN GRANTED? (# OF SUCH ZONES)	Z				
W	137.0	ARE FIELD RECORDS AVAILABLE FOR SUBSURFACE SAFETY DEVICES SHOWING HISTORY AND CURRENT STATUS?	W				
Z	19.?.1	IS EACH TUBING INSTALLATION MADE AFTER 12-1-72, EQUIPPED WITH A DEVICE ACTIVATED BY THE PLATFORM SHUT-IN OR INDEPENDENT REMOTE SHUT-IN SYSTEM IF WELL HAS SHUT-IN TUBING PRESSURE OF LESS THAN 4000 PSIG? (# OF SUCH COMPLETIONS) (COUNT APPROVED SUBSURFACE CONTROLLED DEVICES AS NA)	Z				
Z	192. ?	IS EACH TUBING INSTALLATION MADE AFTER DEC. 1, 1972, EQUIPPED WITH A SUBSURFACE CONTROLLED DEVICE (OR OTHER APPROVED DEVICE) IF WELL HAS SHUT-IN TUBING PRESSURE OF 4,000 PSIG OR GREATER? (# SUCH COMPLETIONS) (COUNT APPROVED SURFACE CONTROLLED DEVICES AS NA)	Z				
Z	102.0	IS OPERATION OF AUTOMATIC WELLHEAD VALVES TESTED WEEKLY? (# ZONES NOT BLIND-FLANGED OR PLUGGED)	Z				
Z	103.0	IS HOLDING PRESSURE, OF AUTOMATIC, WELLHEAD VALVES TESTED MONTHLY? (# OF ZONES NOT BLIND-FLANGED OR PLUGGED)	Z				
W	104.0	ARE THE RESULTS OF ALL AUTOMATIC WELLHEAD SAFETY VALVE TESTS RECORDED AND MAINTAINED IN THE FLD?	W				
-i--	10.0	ARE SPILLS AND LEAKS PROPERLY REPORTED AND RECORDED AND RECORDS AVAILABLE FOR INSPECTION?	W				
Z	107.0	ARE CHECK VALVES TESTED MONTHLY (OR QUARTERLY IF APPLICABLE)? (# OF ZONES NOT BLIND-FLANGED OR PLUGGED)	Z				
W	109.0	ARE THE RESULTS OF ALL CHECK VALVE TESTS RECORDED AND MAINTAINED IN THE FIELD?	W				
P(2)	147.0	ARE PRESSURE SENSORS FOR ZONES AND ALL PRESSURIZED VESSELS TESTED FOR PROPER SETTINGS MONTHLY (OR QUARTERLY IF APPLICABLE)? (TOTAL SENSORS FOR ZONES AND VESSELS)	V				
W	149.0	ARE THE RESULTS OF ALL PRESSURE SENSOR TESTS RECORDED AND MAINTAINED IN THE FIELD?	W				
P(2)	165.0	IF PRODUCED WATER IS DISCHARGED INTO THE GULF, ARE 4 SAMPLES TAKEN DURING 24-HOUR PERIOD, ONCE A MONTH, AND ANALYZED?	V				
P(2)	,6?.1	IS THE OIL CONTENT OF DISPOSED WASTE WATER REDUCED TO AN AVERAGE OF NOT MORE THAN 50 PPM? DATE ___ AVERAGE PPM ___ LOCATION SAMPLING STATION ___	V				
n	62.2	IS COPY OF MOST RECENT (WITHIN TWO MONTHS) LABORATORY ANALYSIS OF DISCHARGED PRODUCED WASTE WATER MAINTAINED ON SITE OR FIELD HEADQUARTERS?	W				
W	17.2	IS COPY OF MOST RECENT (WITHIN 1 YEAR) LABORATORY ANALYSIS OF SEWAGE SYSTEM EFFLUENT MAINTAINED ON PLATFORM?	W				

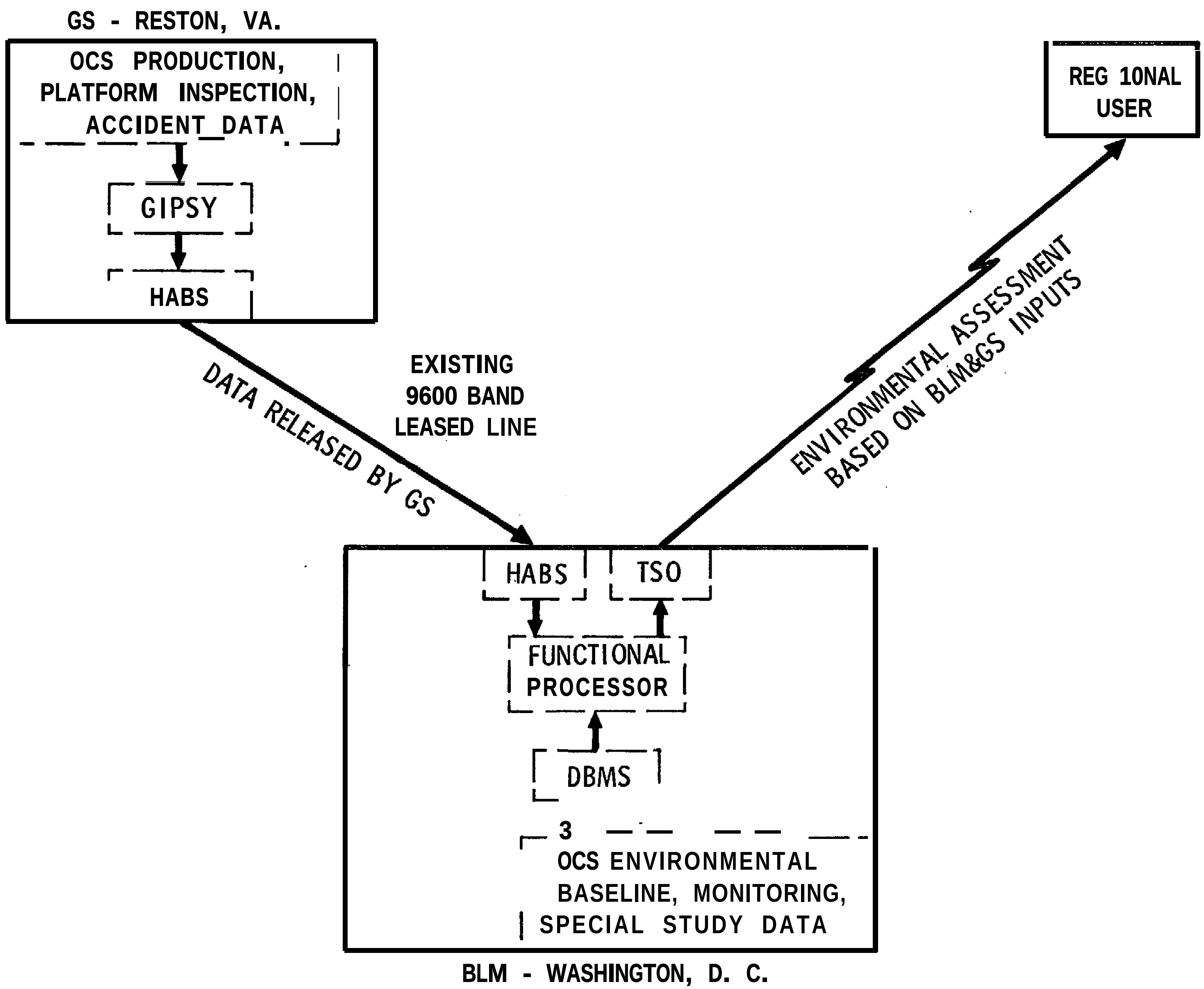


FIGURE 1-6. DATA EXCHANGE